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LIBBY BIOENERGY PROJECT

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LIBBY BIOENERGY PROJECT

Prepared by

Rayson Brothers Logging Company
Route 1, Box 886
Libby, Montana 59923

David G. Van Hersett, P.E.
Resource Development Associates
West 601 Main Avenue, Suite 305
Spokane, Washington 99201

May 1985

Prepared for

Montana Department of Natural Resources and Conservation
1520 East 6th Avenue, Helena, Montana 59620
Renewable Energy and Conservation Program
Grant Agreement Number RAE-84-1045

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A. TITLE PAGE

1. Grantee

Rayson Brothers Logging Company
Route 1, Box 886
Libby, Montana 59923
406/293-9306

2. Project Consultant:

David G. Van Hersett, P.E.
Resource Development Associates
West 601 Main Avenue, Suite 305
Spokane, WA 99201
509/838-8024

3. Location of Project:

Libby, Montana

4. Funding:

Total Project Cost:	$2,421,510
Amount of Grant:	$ 116,000

5. Project Scope:

The Grantee shall investigate, design and document the feasibility of using forest residue in the vicinity of Libby, Montana to replace oil and coal as a long-term, cost-effective, dependable energy supply for the vermiculite drying operation at the W.R. Grace and Company vermiculite mine. The Grantee shall research and document basic information including, but not limited to a site specific data base of wood resources, recovery and combustion technology data, environmental and economic constraints, institutional barriers and interfaces, and the development of specific guidelines for facility sizing for the proposed bioenergy supply and conversion facilities. The Grantee shall develop the conceptual and preliminary engineering designs and cost estimates for all required bioenergy facilities and compare the economics and risks to the present oil facility and to a coal option. The Grantee shall document proven fuel supply systems, fuel supply contracts, permits and licenses, financial, environmental, siting and management requirements. The Grantee shall seek to demonstrate that the proposed energy fuel is a reliable, cost-effective substitute for coal and oil at the W.R. Grace mine. More specifically, the Grantee shall perform the following tasks that have been organized into a sequence of project milestones. The milestones have been organized to provide the most important information as early as possible so that the study can be terminated if the project does not appear feasible.

B. ABSTRACT/EXECUTIVE SUMMARY

During the last decade, the basic cost of energy to produce vermiculite from the W.R. Grace & Co. mine in Libby, Montana has increased faster than other elements of the product production costs. This study looks at waste wood and coal as an alternative to the mine's existing oil and electrical energy suppliers. Waste wood was selected because it is available as a by-product of the long-time well-established local forest products industry in western Montana, northern Idaho and near-by Canadian sawmill operations. In the last decade, two major metallurgical coal mines were opened in Canada 110 miles north of Libby. Waste coal from these operations is available in huge quantities, is a logical alternative to oil and would be competition for waste wood as an energy source.

The objective of this study is to develop the foundation and back-up information to enable Rayson Brothers Logging Company to enter into a long term energy supply contract with W.R. Grace & Co.

To fund this preparatory effort, Rayson Brothers Logging Company secured a matching funds grant from the State of Montana and Bonneville Power Administration. This work began in May of 1984 and was completed in May of 1985.

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- B: Fuel System Cost Performnce
- C: Economics

D. INTRODUCTION

1. Project History and Reason for Current Project.

During the last seven years, the forest products industry has been through several large swings in production levels. This has had a very dramatic effect on the economic performance of the industry and created large swings in employment, especially in the logging industry. Rayson Brothers Logging Company began an aggressive search to develop new markets for their services. Some of these investigations included whole tree chipping and conversion of heating systems in local schools from electric, oil or natural gas to bioenergy fuel. The latter led to contacting W.R. Grace to determine their possible interest in using bioenergy fuels in place of their fossil fuels. W.R. Grace was in the preliminary stages of investigating near-by Canadian fuel as a substitute to oil fuel. Bioenergy fuels would be considered if it could be demonstrated beyond any reasonable doubt that a cost-effective, firm, low risk fuel supply could be provided in direct competition with oil and coal.

The next task was to locate a bioenergy consultant with direct recent experience in the development of utility grade bioenergy resources in our area. Resource Development Associates' Principal, David Van Hersett, has just the experience and background needed. He has participated in the development of five utility grade bioenergy generation facilities in the last five years, ranging from 5 to 42 megawatts in capacity. Additionally, he is a partner in Northwest Cogeneration, a company specializing in the development and financing of bioenergy cogeneration facilities in Northeastern Washington, Northern Idaho and Northwestern Montana. Rayson Brothers and Resource Development Associates subsequently combined their resources to conduct preliminary evaluations of the feasibility of developing a bioenergy supply system as an alternative to coal and oil for the W.R. Grace Mine. The investigations included visits to logging residue recovery operations in Oregon, Washington and Montana, site visits to other potential bioenergy users in Montana and contacts with the State Forest Service in Libby, Montana. Preliminary information was obtained from W.R. Grace to make order-of-magnitude energy cost comparisons for coal, oil and bioenergy fuels.

The preliminary work indicated that continued development was in order. Next, funding was needed for the detailed feasibility study that would be required to convince the W.R. Grace & Co. management that a bioenergy supply system requiring the capital investment of $2 to $5 million would be a better alternative than coal and/or to replace the use of oil at the Libby mining operation. Resource Development Associates contacted the Montana Department of Natural Resources and was told of the Montana Renewable Energy and Conservation Grant Program. This sequence of events is the chronology of this project development.

2. Describe the general and economic findings.

Wood and coal energy are the clear choice over existing oil energy for the vermiculite drying operation. However, it is still cheaper to purchase electricity from the local utility than generating electricity using either wood or coal fuels. All the investigations demonstrated that the W.R. Grace Mine energy requirements were a small percentage of the total reserves available for both wood and coal. In both cases, the energy reserves exceeded 100 years. Both coal and wood can be delivered at the same cost. Wood has the advantage of being entirely locally produced with no foreign influences on its availability. Coal, however would require that a competitive alternative fuel be available; otherwise the long term price of coal would approach the next alternative energy price, oil. Thus, a wood fuel supply system is necessary to assume the long term economic benefits. No environmental barriers were discovered that would preclude the orderly development of the project. Coal has the potential liability of requiring desulfurization equipment, and this cannot be determined until the actual project permit application has proven beneficial to the combustion of both coal and wood fuels. This is an important operating benefit to using both fuels as an alternative to the other in the event of any fuel shortages. Short term shortages or interuptions should be met with existing oil and propane capabilities. From an operating view-point, wood and coal fuels present no operational problems. Existing technology exists to burn oil, coal and wood fuels in any combination.

The utilization of wood fuel requires the use of a gasifier (again well established technology) produced by a third party (Rayson Brothers Logging Company) to secure tax credits. The tax credits enable lower cost financing along with Industiral Development Bonds for the debt portion of the project capital structure. The tax law requires that the gas producing entity be independent of the user to qualify for tax credits. Rayson Brothers would enter into a 15 year energy supply contract with W.R. Grace & Co. to supply low BTU gas. The preceeding business structure allows waste wood to be competitive with coal.

Rayson Brothers Logging Company proposes to install a gasifier adjacent to the vermiculite dryer. Rayson Brothers will be responsible for the wood fuel supply and would use coal as an alternative fuel for long term fuel shortages. Low BTU gas would be sold on a long term contract to W.R. Grace & Company at a price to cover Rayson Brothers costs and a reasonable profit. This price would be negotiated and would be tailored to provide for project financing and the inclusion of tax incentives. Rayson Brothers would like to initiate contract negotiations as soon as possible to provide for operation in the next 12 months.

The general economic findings can be summarized as follows:

Discussion of Electrical Generating Plant

In regard to case #1, it was found that the use of wood waste, at the price quoted, produced an operating loss in each of the 15 years forecast before any debt service or recovery of capital costs. This is in sharp contrast to the forecast results of case #2 which reflects growing operating income over the same 15-year period. Similar revenue and expense assumptions were used in each case, with the cost of fuel being the primary determinant of the dramatic difference in net operating income.

It appears that the best financing alternative for either the wood or the coal fired plant would be industrial development bonds, assuming they are available for such use in Montana at the time of construction. For financial modeling purposes, bonds equal to 90% of cost were amortized over a 25-year period at 10% interest. For the coal fired plant, a positive cash flow is produced each year, providing for a very attractive return on the equity invested.

Since case #1 produced negative operating results throughout its life, it made no sense to look at the financing or after-tax implications for this alternative.

Discussion of Vermiculite Dryer

Because of significantly lower fuel and base capital costs, the coal fired dryer (Case #4) is clearly superior to the wood waste fired dryer (Case #3). However, it would be possible for Rayson Brothers to present an attractive option to coal to W.R. Grace, using wood to produce gas, which in turn would fire the dryer. In this event, Rayson would be in a position to obtain significant tax credits under Section 44D of the Internal Revenue Code. To the extent these could be used to offset tax liabilities that Rayson (or a partnership set up to own the equipment) would otherwise pay, a large portion of the benefit could be passed to W.R. Grace in the form of reduced energy cost. Because of the requirements of the particular tax code section, Grace could not obtain this credit by itself, but could conceivably have up to a 50% ownership interest in the facility.

3. Describe the Bioenergy reserves available, the long-term methods of procuring rights to resources, and the projected annual production areas for the life of the project.

Forest Residue Reserves

Annual forest residue (logging residue and stand conversion residue) produced in the Kootenai National Forest:

Logging residue	1,594,000
Stand conversion residue	244,000
TOTAL ANNUAL RESIDUE	1,838,000

Lowest cost stand conversion residue (less than 40% slope and existing access roads) is 5,556 acres or	111,320 tons
Unroaded stands at less than 40% slope are 7,132 acres, or	142,640 tons
Recoverable stagnated logpole stands	253,960 tons

Note: This does not include beatle kill areas, etc.

Logging Residue

Logging residue recovery will be the main fuel supply source because of its large volume potential of 1,594,000 tons per year.

Waste Wood (Sawmill Waste)

The primary industry in Northwestern Montana is the forest products industry. A study conducted by Charles E. Keegan III and Timothy P. Jackson titled "Mill Residue Availability in the Inland Empire", Bureau of Business and Economic Research, University of Montana, Missoula, Montana concluded that 3,263,000 tons per of mill residue is produced by the sawmills within a 100-mile haul of Libby. Existing pulp mills and board plants use 1,936,000 tons per year; 1,000,000 tons per year is existing log fuel uses, miscellaneous 25,000 tons per year and 288,000 tons per year is unutilized. This report confirms the results of the sawmill fuel survey conducted in Task 201. Our own survey of 26 sawmills within a 100-mile haul of Libby identified 313,000 tons per year of millwaste. Fourteen sawmills producing 168,000 tons per year were identified as potential suppliers.

Residue Rights

The agencies were very supportive of projects to recover material now left on sites following logging. Rights to the residue would have to be obtained through the purchaser of the timber and must be approved by the agency. Generally, slash disposal represents a cost to the timber purchaser, and the purchaser should be willing to arrange for its recovery given the user were willing to pay removal costs. The arrangement for removal must be approved by the agency involved, but both indicated a willingness to approve logging residue provided logging treatments were met.

Stand Conversion Residue

The Kootenai National Forest has in excess of 75,000 acres of stagnant logpole pine stands in need of conversion to better stocked, more productive stands. At present, the forest is paying contractors to fell or slash and pile a portion of these acres annually. Forest officials do not feel they could commit to pay a contractor on a long-term basis to treat these sites by removing all or a portion of the residue.

They do feel long-term contracts to remove the residue from stagnant stands could be made available. They would have to be put up for bid with at least a small payment made to the forest for the residue. Given that no market of any size currently exists (and probably will not exist in the next 10 years) for this kind of residue in the area, contracts would certainly be available for a very minimal cost.

The situation for lands managed by the Montana Division of Forestry would be very similar to that for the Kootenai National Forest.

Rights to residue from stagnant stands or private lands in the area would have to be obtained from individual owners. Because these overstocked stands represent serious land management problems, private landowners in the area should be amenable to a residue recovery proposal which puts these stands in a more productive situation.

E. SYSTEM DESIGN

1. Mass Balance Schematic or Dryer Application
   Refer to drawing 202-3

2. Energy Balance

3. Process Flow Diagram: Refer to drawing 203-3 and drawing 202-6

4. Equipment Descriptions:

The Energy Conversion Facility is a fluidized bed combustor and the associated fuel feed and temporary storage system. Figure 202-3 shows the process heat balance for the combustor, and Figure 202-6 shows the process diagram for the fuel handling and storage system at the combustor. Please refer to the Phase I descriptions for Tasks 105 and 108 for the description of the fluidized bed combustor and the secondary fuel storage facility. Figure's 202-7 & 8 show the equipment plan and elevation layouts. Figure 202-10 shows the site plan at the top of the hill, and Figure 202-11 shows the site plan at the bottom of the hill adjacent to the primary fuel handling and storage facility. The fluidized bed combustor and the fuel feed system have been designed to accommodate either coal or sized wood waste.

The configuration "c", fluidized bed combustor to heat the vermiculite dryer is shown on the site plan Figure 202-13. The fluidized bed combustor is discussed in Phase I; however, the cogeneration power plant has not been included here.

Fuel Receiving and Handling Systems

The fuel receiving and storage facilities adjacent to the fluidized bed combustor at the top of the hill are shown schematically on Figure 202-6 and on the site plan on Figure 202-10. Please refer to the Phase I Report Task 105 for the detail description of this system.

Emission Control Systems

The configuration that has a fluidized bed combustor at the top of the hill uses a multiple cyclone particulate collector and the existing vermiculite dryer fabric filter dust collector (bag house) to reduce the particulate emissions for the combustor ash carryover and the dryer dust carryover. Gaseous emissions such as oxides of nitrogen, carbon dioxide and sulfur dioxide will be untreated. The nitrogen oxides and the carbon dioxide levels will be equal to or less than the existing oil fired burner emissions for both the wood and coal fuel cases. The coal, however, has a small amount of sulfur (0.3%) that will produce about 85.8 tons per year of sulfur dioxide.

Fluidized Bed Energy Conversion System Performance Requirements

A. A system utilizing wood waste or coal shall produce 24.8 MMBTU/hr. in the form of blended hot exhaust gasses at 850 degrees F and 108,000 to 125,000 pounds per hour for use in a vermiculite dryer. The system is to be located near Libby, Montana at an approximate 3500 foot elevation.

B. The scope of supply of the fluidized bed energy conversion system shall include all equipment, materials and installation from the fuel dump hopper through the connection at the vermiculite dryer, including all auxiliaries.

C. The exhaust shall be cleaned prior to entering the dryer so that there is less than 0.8 gr/SCF of particles 10 microns or larger.

D. The fuel feed system must handle wood waste sized to three inches minus and coal three-eights inch minus without significant modification or operator interaction.

E. The dual feed and storage system shall be able to supply enough fuel for 100% output for 16 hours.

F. The fuel burn rate shall be less than 6200 #/hr. for wood at 4000 BTU/# and 3260 #/hr for coal at 8,000 BTU/# at the rated output.

G. An ash removal system shall be provided for manual or automatic ash removal from the combustor and mechanical separator.

H. All controls for fuel feed and combustion air flow are to be included.

I. All structural steel, component support steel and access platforms are to be included.

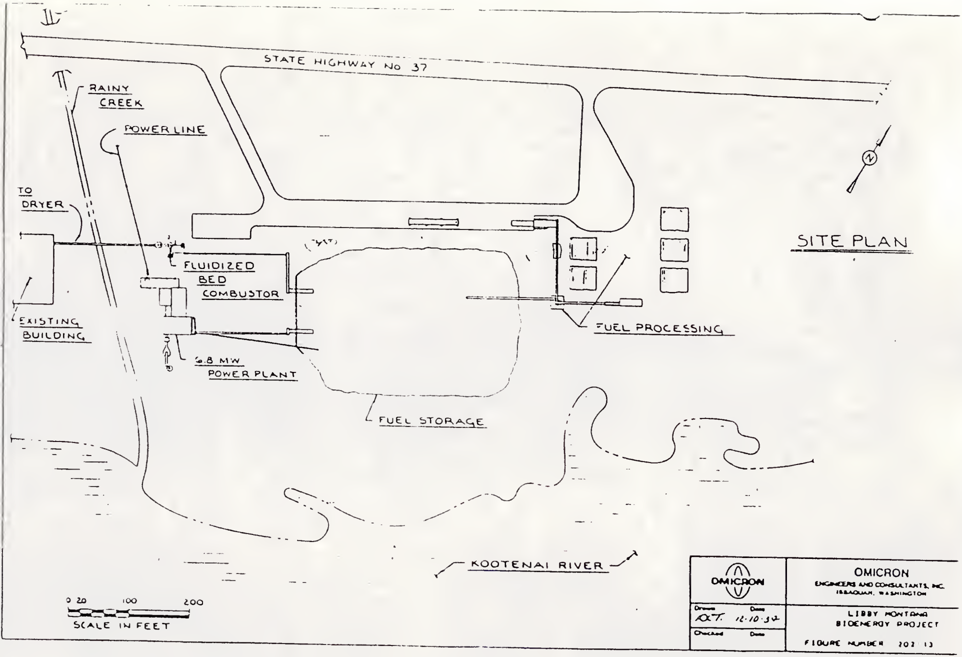
J. The installation services shall include site preparation, 30-day startup and operator training.

5. Preliminary

The following is a listing of the figures that comprise the conceptual drawings for Task 202:

Figure Number	Description
202-3	System diagram & heat balance fluid bed combustor
202-6	System diagram fuel handling & storage for fluid bed combustor
202-7	Plan view-fluid bed combustor
202-10	Site plan-fluid bed combustor

Figure Number	Description
202-11	Site plan-fluid bed combustor and fuel handling at river
202-13	Site plan-fluid bed & cogen. plant at river



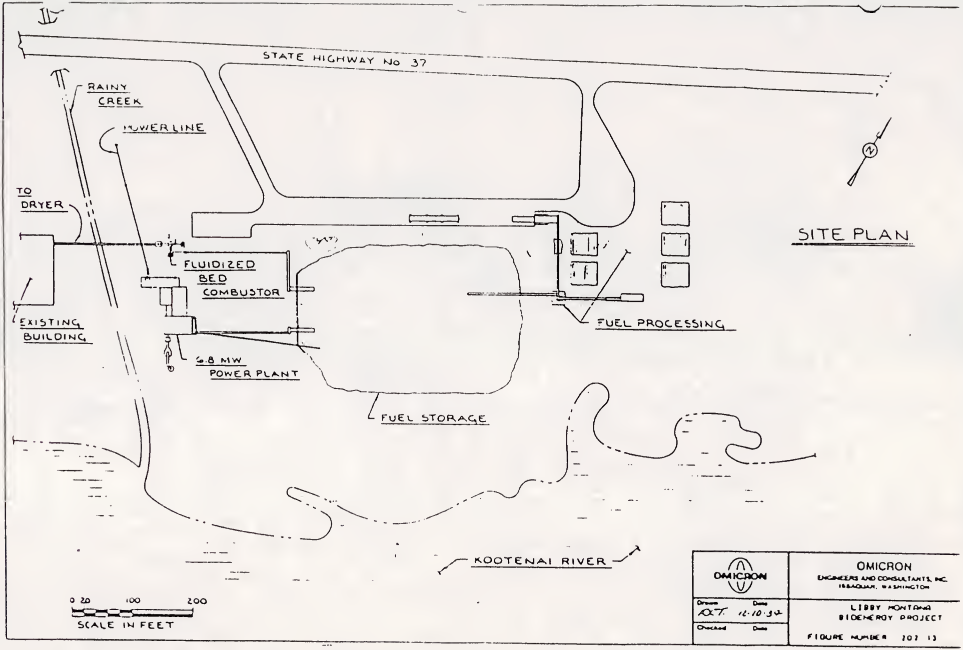
SITE PLAN

OMICRON
ENGINEERS AND CONSULTANTS, INC.
ISSAQUAH, WASHINGTON

Drawn A.T. Date 12·10·92
Checked Date

LIBBY MONTANA
BIOENERGY PROJECT

FIGURE NUMBER 202-13



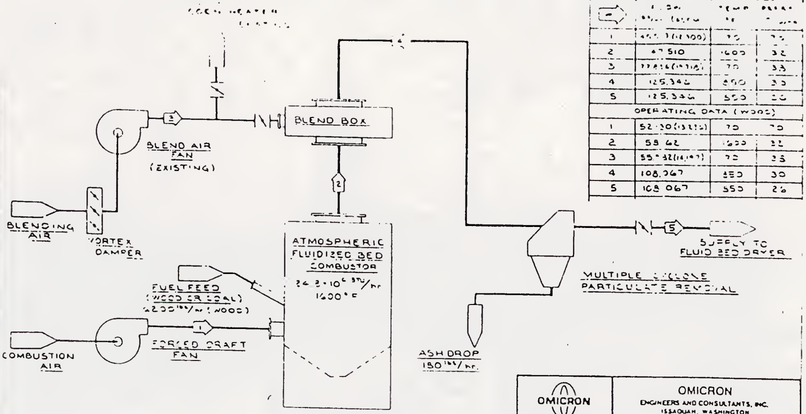
SITE PLAN

OMICRON
ENGINEERS AND CONSULTANTS, INC.
ISSAQUAH, WASHINGTON

Drawn AKT. Date 12·10·92
Checked Date

LIBBY MONTANA
BIOENERGY PROJECT

FIGURE NUMBER 207 13



OPERATING DATA (COAL)			
	FLOW lbs/hr (ACFM)	TEMP °F	PRESS " wg
1	[illegible] (12,100)	70	70
2	47,510	1600	32
3	[illegible]	70	35
4	125,346	550	30
5	125,346	550	26
OPERATING DATA (WOOD)			
1	52,30[illegible]	70	70
2	55,62	1600	32
3	55,[illegible]32 (14,197)	70	35
4	108,067	550	30
5	108,067	550	26

(ALTITUDE 3500' ABOVE SEA LEVEL)

SOLID FUEL
COMBUSTION DIAGRAM

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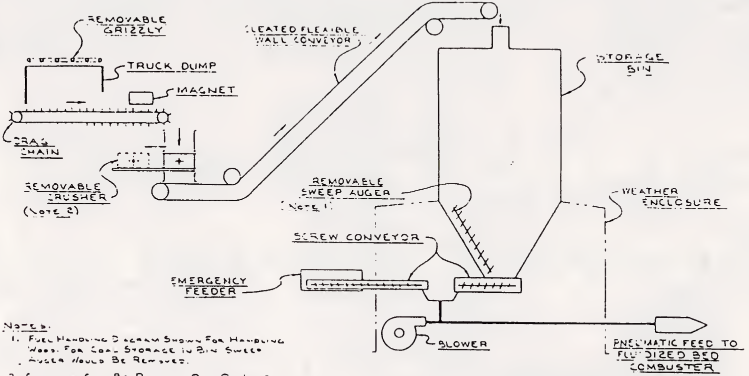
FIGURE NUMBER 202-3


REMOVABLE GRIZZLY
TRUCK DUMP
MAGNET
DRAG CHAIN
REMOVABLE CRUSHER (NOTE 2)
CLEATED FLEXIBLE WALL CONVEYOR
STORAGE BIN
REMOVABLE SWEEP AUGER (NOTE 1)
WEATHER ENCLOSURE
SCREW CONVEYOR
EMERGENCY FEEDER
BLOWER
PNEUMATIC FEED TO FLUIDIZED BED COMBUSTER

NOTES:

1. FUEL HANDLING DIAGRAM SHOWN FOR HANDLING WOOD. FOR COAL STORAGE IN BIN SWEEP AUGER WOULD BE REMOVED.
2. CRUSHER CAN BE PULLED OUT OF LINE FOR MAINTENANCE OR DURING NON-FREEZING MONTHS.

FUEL HANDLING DIAGRAM

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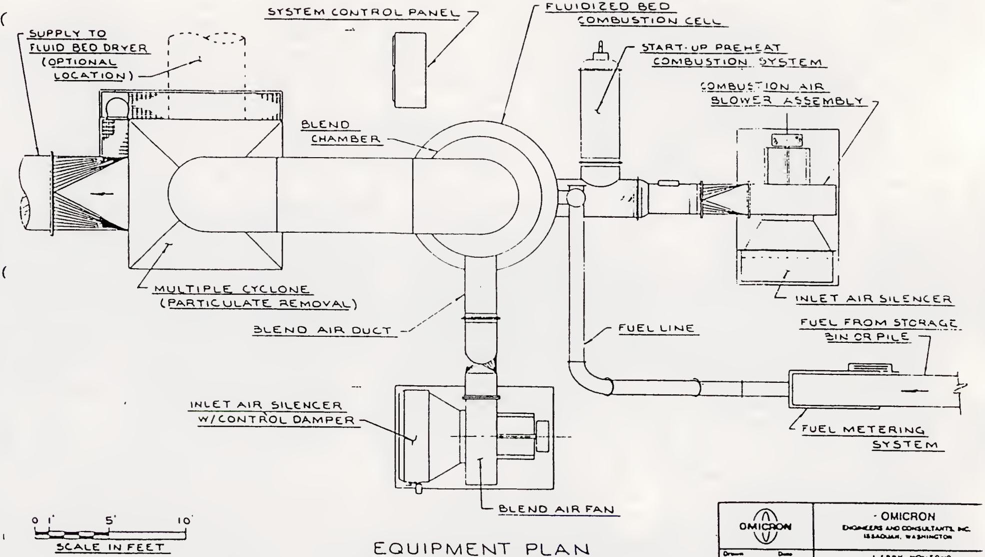
FIGURE NUMBER 202·6


SYSTEM CONTROL PANEL
FLUIDIZED BED COMBUSTION CELL
SUPPLY TO FLUID BED DRYER (OPTIONAL LOCATION)
START-UP PREHEAT COMBUSTION SYSTEM
COMBUSTION AIR BLOWER ASSEMBLY
BLEND CHAMBER
MULTIPLE CYCLONE (PARTICULATE REMOVAL)
INLET AIR SILENCER
BLEND AIR DUCT
FUEL LINE
FUEL FROM STORAGE BIN OR PILE
INLET AIR SILENCER W/CONTROL DAMPER
FUEL METERING SYSTEM
BLEND AIR FAN
0 1' 5' 10'
SCALE IN FEET

EQUIPMENT PLAN
FLUIDIZED BED COMBUSTOR

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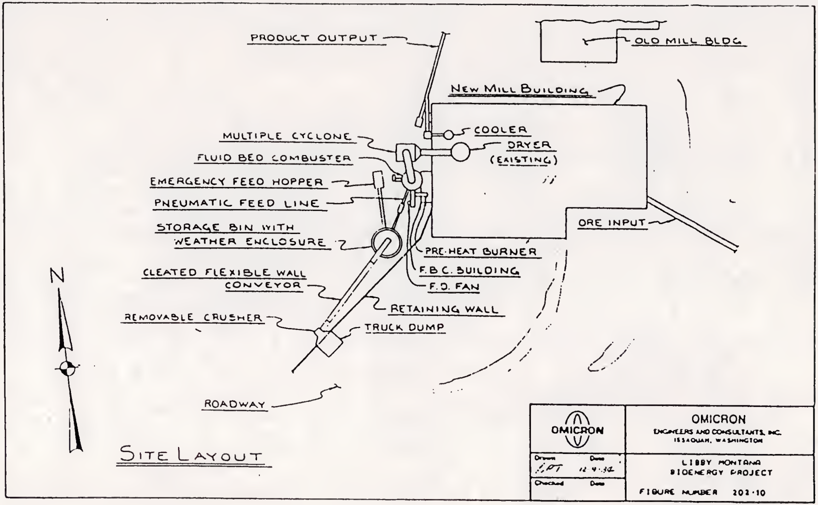
ENGINEERS AND CONSULTANTS, INC.
ISSAQUAH, WASHINGTON

Drawn Date
12-12-83

Checked Date

LIBBY MONTANA
BIOENERGY PROJECT

FIGURE NUMBER 203-1



SITE LAYOUT

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Checked	Date

LIBBY MONTANA
BIOENERGY PROJECT

FIGURE NUMBER 202-10

6. Assumptions and calculations used in the design of the biomass and coal supply and conversion system, appended:

Area		Reference
Mine Energy Requirements		Task 104
Facility Design	(Wood)	Task 105
	(Coal)	Task 107
	(Coal)	Task 108
Fuel Supply	(Wood)	Task 106
	(Wood & Coal)	Task 203
	(Wood)	Task 102
	(Coal)	Task 107
	(Wood)	Task 201

F. ECONOMICS

1. Summarize the project's overall economics.

The following four alternatives have been analyzed.

Case 1.) Electrical generating plant utilizing wood waste as a primary fuel source;

Case 2.) Electrical generating plant utilizing coal as a primary fuel source;

Case 3.) Vermiculite dryer utilizing wood as a primary fuel source; and

Case 4.) Vermiculite dryer utilizing coal as a primary fuel source.

Please see Schedule A for the assumptions used for each of these cases.

Conclusion

Cases #2 and #4 above were compared with Cases #1 and #3, respectively. In both instances, it was found that coal was the least expensive fuel source. However, if W.R. Grace is willing to contract with a third party to supply gas produced from wood, then an attractive alternative to Case #3 would exist. Depending upon the arrangement worked out between the parties, Case #3, as modified, could be less expensive to W.R. Grace than Case #4.

Discussion of Electrical Generating Plant

In regard to Case #1, it was found that the use of wood waste, at the price quoted, produced an operating loss in each of the 15 years forecast before any debt service or recovery of capital costs. This is in sharp contrast to the forecast results of Case #2 which reflects growing operating income over the same 15-year period. Similar revenue and expense assumptions were used in each case, with the cost of fuel being the primary determinant of the dramatic difference in net operating income.

It appears that the best financing alternative for either the wood or the coal fired plant would be industrial development bonds, assuming they are available for such use in Montana at the time of construction. For financial modeling purposes, bonds equal to 90% of cost were amortized over a 25-year period at 10% interest. For the coal fired plant, in each year a positive cash flow is produced, providing for a very attractive return on the equity invested.

Since Case #1 produced negative operating results throughout its life, it made no sense to look at the financing or after-tax implications for this alternative.

Discussion of Vermiculite Dryer

Because of significantly lower fuel and base capital costs, the coal fired dryer (Case #4) is clearly superior to the wood waste fire dryer (Case #3). However, it would be possible for Rayson Brothers to present an attractive option to coal to W.R. Grace, using wood to produce gas, which in turn would fire the dryer. In this event, Rayson would be in a position to obtain significant tax credits under Section 44D of the Internal Revenue Code. To the extent these could be used to offset tax liabilities that Rayson (or a partnership set up to own the equipment) would otherwise pay, a large portion of the benefit could be passed to W.R. Grace in the form of reduced energy costs. Because of the requirements of the particular tax code section, Grace could not obtain this credit by itself, but could conceivably have up to a 50% ownership interest in the facility.

2. Update the energy and cost savings at the vermiculite mine as a result of using the biomass-fired drying conversion and supply system.

	Oil Primary Fuel	Wood Primary Fuel	Coal Primary Fuel
Fuel Quantity Required	552,930 gal.	12,000 tons	5300 tons
Heat Content	120,000 Btu/lb	4,500 Btu/lb	8000 Btu/ton
Commodity Price (FOB Mine)	$0.664/gal	$9.50/ton (206)	$15.46/ton
Cost per Million BTU	$5.53	$1.056	$ 0.966
Annual Fuel Cost* (FOB Mine)	(367,080)	($114,000)	($87,238)

3. Summarize the project sensitivity to principal costs such as financing, fossil fuel cost and raw materials.

In the previous paragraph, the financial summary analysis describes the results of several options in which the variables of capital, fuel cost and tax incentives were evaluated. The objective was to determine the break-even point between wood and coal as a viable option to the existing oil. Fuel cost sensitivity is illustrated by the $9.50 per ton recommended cost to meet the delivered coal price. This price requirement effectively rules out the higher cost forest residue recovery as a short term viable option.

Capital cost sensitivity will be established during negotiations with W.R. Grace. The capital recovery criteria will be set by the length of energy contract they are willing to execute with Rayson Brothers.

In general, a 10 percent increase in project capital cost would require a 20 percent reduction in fuel cost for the economic performance to remain unchanged.

G. GRANT ADMINISTRATION

1. Work Schedule: Compare the time alloted for the completion of the project with what actually happened, identifying delays and determining whether the delays were unique to the project.

ACTUAL VA SCHEDULED PROGRESS

Milestone	Scheduled			Actual		
	Start	End	Duration	Start	End	Duration
1	6/84	8/84	2 mo	6/84	8/84	2 mo
2	6/84	8/84	2 mo	6/84	8/84	2 mo
3	9/84	10/84	2 mo	10/84	1/85	3 mo
4	9/84	10/84	2 mo	10/84	5/85	7 mo
5	10/84	12/84	3 mo	11/84	5/85	6 mo

Events by Milestone

Milestone No. 1 and No. 2: This work schedule proceeded on schedule. This would be expected, as the individual work tasks were primarily data gathering and resource identification.

Milestone No. 3: This work schedule hit right at the winter holiday season. Scheduling meetings with so many parties and the holidays created time delays. The result was to add one month of time. All participating organizations and individuals worked very well together to assist in the orderly progress of this feasibility study effort. This is actually quite an accomplishment when you consider that 11 parties were working directly on the project and we contacted 12 governmental agencies and 11 private parties for information.

Milestone No. 4: This activity was the real heart of this project. The time stretched out because it became very difficult to deliver a bioenergy delivery system that would meet the competition of coal. This conclusion was known in December 1984. It took until April to develop the recommended bioenergy system presented in the report. The delays were not necessarily unique, but represent the effort, imagination and tenacity of the Rayson Brothers team to develop a new industry in the Libby area. Creation of a new income-producing job utilizing the forest residue and existing labor skills is paramount to the long term survival of Rayson Brothers Logging Company.

Milestone No. 5: Once the cometitive bioenergy system had been identified, the completion of this activity proceeded in an orderly and timely manner.

In summary, the project proceeded very well, and no major work problems were encountered. The delay was the time required to develop a competitive solution. This extra time could be classified as unique for two reasons: (1) Normally wood would be competitive with domestic coal, however, the proximity of Canadian coal with an unusually low sulfur content is unusual, and (2) normally a waste wood fueled facility does not require major tax incentives to meet fossil fuel competition.

2. Project Budget Summary

Cost Category	DNRC Cost Totals (From Budget Detail Sheets)	Proposer Contribution	Other Outside Sources	Total
1. Salaries & Wages	$ 25,360	$ 64,159	$ 66,159	$155,897
2. Fringe Benefits	included above	included above	included above	
3. Contracted Services	85,510	1,600		87,110
4. Supplies & Materials	1,000			1,000
5. Communications				
6. Travel	4,130	3,778	2,167	10,075
WORK PLAN DEVELOPMENT TOTAL	$116,000	$69,537	$68,527	$254,064

H. RESULTS AND CONCLUSIONS

1. Summarize the major findings and recommendations:

Phase II Management Review

Introduction

During the last decade, the basic cost of energy to produce vermiculite from the W.R. Grace & Co. mine in Libby, Montana has increased faster than other elements of the product production costs. This study looks at waste wood and coal as an alternative to the mine's existing oil and electrical energy suppliers. Waste wood was selected because it is available as a by-product of the long-time, well-established local forest products industry in Western Montana, Northern Idaho and near-by Canadian sawmill operations. In the last decade, two major metallurgical coal mines were opened up in Canada 110 miles north of Libby. Waste coal from these operations is available in huge quantities, is a logical alternative to oil and would be competition for waste wood as an energy source.

The objective of this study is to develop the foundation and back-up information to enable Rayson Brothers Logging Company to enter into a long-term energy supply contract with W.R. Grace & Co.

To fund this preparatory effort, Rayson Brothers Logging Company secured a matching funds grant from the State of Montana and Bonneville Power Administration. This work began in May of 1984 and was completed in May of 1985.

Executive Summary

Wood and coal energy are the clear choice over existing oil energy for the vermiculite drying operation. However, it is still cheaper to purchase electricity from the local utility than generating electricity using either wood or coal fuels. All the investigations demonstrated that the W.R. Grace Mine energy requirements were a small percentage of the total reserves available for both wood and coal. In both cases, the energy reserves exceeded 100 years. Both coal and wood can be delivered at the same cost. Wood has the advantage of being entirely locally produced with no foreign influences on its availability. Coal, however, would require that a competitive alternative fuel be available; otherwise the long-term price of coal would approach the next alternative energy price, oil. Thus, a wood fuel supply system is necessary to assume the long term economic benefits. No environmental barriers were discovered that would preclude the orderly development of the project. Coal has the potential liability of requiring desulfurization equipment, and this cannot be determined until the actual project permit application has been turned in to the State. Blending coal and wood has proven beneficial to the combustion of both coal and wood fuels. This is an important operating benefit to using both fuels as an alternative to the other in event of any fuel shortages. Short-term shortages or interruptions should be met with existing oil and propane capabilities. From an operating viewpoint, wood and coal fuels present no operational problems. Exisiting technology exists to burn oil, coal and wood fuels in any combination.

The utilization of wood fuel requires the use of a gasifier (again well-established technology) produced by a third party (Rayson Brothers Logging Company) to secure tax credits. The tax credits enable lower cost financing along with industrial development bonds for the debt portion of the project capital structure. The tax law requires that the gas producing entity be independent of the user to qualify for tax credits. Rayson Brothers would enter into a 15-year energy supply contract with W.R. Grace & Co. to supply low BTU gas. The preceding business structure allows waste wood to be competitive with coal.

Rayson Brothers Logging Company proposes to install a gasifier adjacent to the vermiculite dryer. Rayson Brothers will be responsible for the wood fuel for long term fuel shortages. Low BTU gas would be sold on a long-term contract to W.R. Grace & Company at a price to cover Rayson Brothers costs and a reasonable profit. The price would be negotiated and would be tailored to provide for project financing and the inclusion of tax incentives. Rayson Brothers would like to initiate contract negotiations as soon as possible to provide for operation in the next 12 months.

Results and Conclusions: Dryer Only

	Wood	Coal
Fuel Requirements	12,000 tons/year	5,300 tons/ea
Fuel Reserves Available	313,000 tons/year produced in area	500,000 ton/year produced at mines
Fuel Cost (FOB Libby)	$9.50/ton	$15.46/ton
cost per million Btu	$1.056	$ 0.966
(oil cost-$587,000 @ $5.53/MMBTU)	$114,000	$81,938
	(Existing Technology)	
Technology	Fluidized bed gasifier	Fluidized bed gasifier
Environmental	Meets all requirements	Meets all requirements (Potential addition of sulfur collection equipment)
Financing	Rayson Brothers or Third Party	W.R. Grace & Co.

2. Identify required permits, licenses and authorizing agencies:

1. Corps of Engineers - required only if any dredge or fill activity or other work affects the river of wetlands. Of particular concern is erosion of river bank as a result of contruction.
2. Ash Disposal - Ash from the plant would be disposed of on W.R. Grace property along with the mine tailings. Woodwaste ash and coal ash contain no hazardous substances. W.R. Grace is already permitted to dispose of mine wastes. Ash from the plant would be insignificant compared to the tons of waste disposed of by the mine. It is unlikely that a special permit will be required, however, the process and timetable are included in the permit timetable following this section.
3. Wastewater Disposal - (Process Wastewater) Discharge permit required from the Department of Health and Environmental Sciences, Water Quality Bureau.
4. Domestic Wastewater Disposal - On-site sewage disposal permit required from Lincoln County.
5. Flood Plain Permit - Required from Lincoln County if the area of the site is within the flood plain boundaries (approximately 200 feet from shoreline).
6. Building Permit - A permit from Montana State Building Division is required prior to any construction.
7. Air Quality Permit - The EPA - PSD permit and the Montana State permit are both handled through Montana State. One application form is required. The air quality in the Libby area is somewhat sensitive, but depending on the amount of fuel burned, licensing should be possible without major problems. If woodwaste is burned, the emissions are low enough that the plant does not qualify as a major stationary source and is not subject to PSD permitting. Montana State officials could not anticipate any problems in procuring a state permit for wood. If coal is used as fuel, the coal may affect the permit process and the cost of pollution equipment.

Permitting Timetable

The Montana Air Quality permit will take the longest to procure, with a six-month lead time. The timetable on the following page shows each permit and the process and time involved.

3. Summarize additional work on development needed, the W.R. Grace management decision, and how the project could have been improved.

For the project to come to reality, Rayson Brothers and W.R. Grace & Co. must successfully negotiate an energy services agreement for a minimum 15-year term. These negotiations must be completed in a manner to insure the utilization of tax credits under section 44D of the Internal Revenue Code and the use of Industrial Development Bonds. The current proposed tax law changes under consideration suggest that immediate action would be prudent to minimize the loss of tax incentives.

Additionally, W.R. Grace & Co. must have confidence that the 15-year outlook for their product is stable. These two preceding decisions will determine the future of this project. These decisions are in areas outside the influence of this report.

The project could have been improved if the Canadian coal had not been so cheap and the price of oil not leveled off during the last two years. The recent stability in world oil prices has taken off the economic pressure to find an alternative to oil.

Throughout the entire project, all involved enjoyed excellent cooperation of all parties participating in this work. This creates a favorable environment to the development of new industry.

One suggestion to assist the development of our waste wood renewable project would be to use the coal severance tax to provide an incentive over a long term -- say 15 years -- to allow the development of this alternative energy project. It would seem that since coal is the major roadblock to this renewable bioenergy project, coal taxes could be used to make it possible.

I. SLIDE SHOW DEVELOPMENT

1. 150 slides were taken of the following areas:

   - .Whole tree chipping plant at LaGrande, Oregon
   - .In-woods forest residue recovery operation at LaGrande, Oregon
   - .Conventional logging equipment used in regular logging operations
   - .Existing sawmill wood waste at Kalispell, Montana
   - .Whole tree chipping plant at Usk, Washington
   - .Wafer board whole tree chipping, Chilco, Idaho
   - .In-woods forest recovery operation at Port Angeles, Washington
   - .Universal refiner for hogging wood waste at Montesanto, Washington

2. Each slide has been numbered to correspond with the following script.

3. The following is the script for the prepared slide show:

Introduction:

During the last decade, the basic cost of energy to produce vermiculite from the W.R. Grace & Co. mine in Libby, Montana has increased faster than other elements of the product production costs. This study looks at waste wood and coal as an alternative to the mine's existing oil and electrical energy suppliers. Waste wood was selected because it is available as a by-product of the long-time, well-established local forest products industry in Western Montana, Northern Idaho and near-by Canadian sawmill operations. In the last decade, two major metallurgical coal mines were opened up in Canada 110 miles north of Libby. Waste coal from these operations is available in huge quantities, is a logical alternative to oil and would be competition for waste wood as an energy source.

The objective of this study is to develop the foundation and back-up information to enable Rayson Brothers Logging Company to enter into a long-term energy supply contract with W.R. Grace & Co.

To fund this preparatory effort, Rayson Brothers Logging Company secured a matching funds grant from the State of Montana and Bonneville Power Administration. This work began in May of 1984 and was completed in May of 1985.

General Results and Economic Findings:

Wood and coal energy are the clear choice over existing oil energy for the vermiculite drying operation. However, it is still cheaper to purchase electricity from the local utility than generating electricity using either wood or coal fuels. All the investigations demonstrated that the W.R. Grace Mine energy requirements were a small percentage of the total reserves available for both wood and coal. In both cases, the energy reserves exceeded 100 years. Both coal and wood can be delivered at the same cost. Wood has the advantage of being entirely locally produced with no foreign influences on its availability. Coal, however, would require that a competitive alternative fuel be available; otherwise, the long-term price of coal would approach the next alternative energy price, oil. Thus, a wood fuel supply system is necessary to assume the long term economic benefits. No environmental barriers were discovered that would preclude the orderly development of the project. Coal has the potential liability of requiring desulfurization equipment, and this cannot be determined until the actual project permit application has been turned in to the State. Blending coal and wood has proven beneficial to the combustion of both coal and wood fuels. This is an important operating benefit to using both fuels as an alternative to the other in event of any fuel shortages. Short-term shortages or interruptions should be met with existing oil and propane capabilities. From an operating viewpoint, wood and coal fuels present no operational problems. Existing technology exists to burn oil, coal and wood fuels in any combination.

The utilization of wood fuel requires the use of a gasifier (again well established technology) produced by a third party (Rayson Brothers Logging Company) to secure tax credits. The tax credits enable lower cost financing along with industrial development bonds for the debt portion of the project capital structure. The tax law requires that the gas producing entity be independent of the user to qualify for tax credits. Rayson Brothers would enter into a 15-year energy supply contract with W.R. Grace & Co. to supply low BTU gas. The preceding business structure allows waste wood to be competitive with coal.

Rayson Brothers Logging Company proposes to install a gasifier adjacent to the vermiculite dryer. Rayson Brothers will be responsible for the wood fuel for long-term fuel shortages. Low BTU gas would be sold on a long-term contract to W.R. Grace & Company at a price to cover Rayson Brothers costs and a reasonable profit. The price would be negotiated and would be tailored to provide for project financing and the inclusion of tax incentives. Rayson Brothers would like to initiate contract negotiations as soon as possible to provide for operation in the next 12 months.

GENE CHRISMANE CHIPPING PLANT LA GRANDE, OREGON

1) Chipping Plant from Air
2) Dick Gregerson (W.R. Grace Engineer who flew us to LaGrande, Oregon)
3) Morbark Whole Tree Chipper
4) Morbark Whole Tree Chipper
5) Morbark Whole Tree Chipper
6) Morbark Whole Tree Chipper
7) Deck of Material used by this Operation
8) Loader that puts logs into system
9) Debarker
10) Front end loader - Also used to put logs into system
11) Morbark chipper being operated - filling chip van
12) Morbark chipper being operated - filling chip van
13) Morbark chipper being operated - filling chip van
14) Morbark chipper being operated - filling chip van
15) Morbark chipper being operated - filling chip van
16) Morbark chipper being operated - filling chip van
17) Morbark chipper being operated - filling chip van
18) Morbark chipper being operated - filling chip van
19) Various equipment in chip yard - chipper in background
20) Various equipment in chip yard
21) Various equipment in chip yard

GENE CHRISMANE WOODS OPERATION LA GRANDE, OREGON

22) Mr. Munsey, Manager of LaGrande operation
23) Landing where chipping is done - chip vans & chipper
24) Landing where chipping is done - chip vans & chipper
25) Inside of chip vans, being loaded
26) Inside of chip vans, being loaded
27) Morbark chipper in place for chipping & loading
28) Morbark chipper in place for chipping & loading
29) Morbark chipper in place for chipping & loading
30) J D 640 Grapple skidder, used to skid to chipper
31) J D 640 Grapple skidder, used to skid to chipper
32) J D 640 Grapple skidder, used to skid to chipper
33) J D 640 Grapple skidder, used to skid to chipper
34) J D 640 Grapple skidder, used to skid to chipper
35) Skidder putting tree lengths in place by chipper
36) Skidder putting tree lengths in place by chipper
37) Bobcat feller buncher
38) Bobcat feller buncher
39) Bobcat feller buncher
40) Bobcat feller buncher
41) Bobcat feller buncher
42) Bobcat feller buncher
43) Bobcat feller buncher
44) Bobcat feller buncher
45) Bobcat feller buncher

CONVENTIONAL LOGGING EQUIPMENT (OA) REGULAR LOGGING OPERATION

46) J D 550 crawler
47) J D 550 crawler
48) J D 540 rubber tire skidder
49) J D 540 rubber tire skidder
50) J D 540 rubber tire skidder
51) 4 WD pick up and tools and equipment used in conventional logging operations

SOME OF EXISTING MATERIAL AVAILABLE FOR LIBBY OPERATION

52) Hog piles in Kalispell
53) Hog piles in Kalispell
54) Hog piles in Kalispell
55) Hog piles in Kalispell
56) Hog piles in Kalispell

BOB HERMISON OPERATION - USK, WASHINGTON

57) Chipping Plant
58) Unloading truck at plant
59) Chain feed into plant
60) Same as 59
61) From chain into conveyor to debarker
62) Debarker
63) Moving van into position to be loaded with chips
64) Van being loaded
65) Morbark chipping unit
66) Morbark chipping unit
67) Morbark knife sharpener for chipper
68) Morbark knife sharpener for chipper
69) Front end loader piling dirty hog fuel
70) Cat feller buncher

L. P. OPERATION CHILCO, IDAHO

71) Water board plant receiving 100" bolts
72) 100" bolts being cut for wafering
73) Equipment used in woods operation
74) Equipment used in woods operation
75) Equipment used in woods operation
76) Maneri 33 Feller buncher - it snips, limbs, tops & bunches
77) Maneri 33 Feller buncher
78) Maneri 33 Feller buncher
79) Maneri 33 Feller buncher
80) Maneri 33 Feller buncher
81) Maneri 33 Feller buncher
82) Maneri 33 Feller buncher
83) Butts of felled trees
84) Deck on Landing
85 & 86) Before & after felling
87) Stagnated lodgepole & beetle-killed lodgepole utilized by this operation & many others
90) Stagnated lodgepole & beetle-killed lodgepole utilized by this operation & many others

HERMAN BROTHERS OPERATION PORT ANGELES, WASHINGTON

91) In woods chipping area
92) Hahn Harvester cuts limbs and tops tree lengths
93) Hahn Harvester cuts limbs and tops tree lengths
94) Nickolson chipper for making hog fuel (utilized limbs & tops)
95) Nickolson chipper for making hog fuel (utilized limbs & tops)
96) Nickolson chipper for making hog fuel (utilized limbs & tops)
97) Nickolson chipper for making hog fuel (utilized limbs & tops)
98) Morbark chipper for pulp chips (utilized debarked logs & slabs from portable mill on site)
99) Morbark chipper for pulp chips (utilized debarked logs & slabs from portable mill on site)
100) Debarked logs for pulp chips
101) J D hydraulic loader used for bucking tree lengths
102) FMC crawler used for skidding logs in woods operation
103) Cat loader used for loading logs & also feller buncher
104) Cat loader used for loading logs & also feller buncher
105) Herman brothers wood operation
106) J D Feller buncher
107) J D Feller buncher
108) J D Feller buncher
109) J D Feller buncher
110) J D Feller buncher
111) Timber Jack clam bunk used for skidding tree lengths
112) Morbark portable saw mill on chipping site
113) Morbark portable saw mill on chipping site
114) Morbark portable saw mill on chipping site
115) Morbark portable saw mill on chipping site
116) Morbark portable saw mill on chipping site
117) Clearcut & selective cuts using clam bund & feller bunchers
118) Clearcut & selective cuts using clam bund & feller bunchers
119) Clearcut & selective cuts using clam bund & feller bunchers
120) Selective cut
121) Timber jack clam bunk in operation
122) Timber jack clam bunk in operation
123) Timber jack clam bunk in operation
124) Timber jack clam bunk in operation
125) Timber jack clam bunk in operation
126) Timber jack clam bunk in operation
127) Timber jack clam bunk in operation
128) Timber jack clam bunk in operation
129) Timber jack clam bunk in operation

UNIVERSAL REFINER FOR HOGGING WOOD WASTE

130) U.R. in Montesanto, Washington
131) U.R. in Montesanto, Washington
132) U.R. in Montesanto, Washington
133) Electric motor on U.R.
134) U.R.
135) Material just before it drops into refiner
136) Material just before it drops into refiner
137) Inside of U.R.
138) Inside of U.R.
139) Inside of U.R.
140) Inside of U.R.
141) After product of U.R.
142) After product of U.R.
143) After product of U.R.
144) Dick Hall salesman of U.R.
145) Area on W.R. Grace land where plant is to be located
146) Area on W.R. Grace land where plant is to be located
147) Area on W.R. Grace land where plant is to be located
148) Area on W.R. Grace land where plant is to be located
149) Area on W.R. Grace land where plant is to be located
150) Area on W.R. Grace land where plant is to be located

TITLE PAGE

1. Grantee:

Rayson Brothers Logging Company
Route 3, Box 995
Libby, Montana 59923
406/293-9306

2. Project Consultant:

David G. Van Hersett, P.E.
Resource Development Associates
West 601 Main Avenue, Suite 305
Spokane, WA 99201
509/838-8024

3. Location of Project:

Libby, Montana

4. Funding:

Total Project Cost:	$2,421,510
Amount of Grant:	$ 116,000

5. Project Scope:

The Grantee shall investigate, design and document the feasibility of using forest residue in the vicinity of Libby, Montana to replace oil and coal as a long-term, cost-effective, dependable energy supply for the vermiculite drying operation at the W.R. Grace and Company vermiculite mine. The Grantee shall research and document basic information including, but not limited to a site specific data base of wood resources, recovery and combustion technology data, environmental and economic constraints, instructional barriers and interfaces, and the development of specific guidelines for facility sizing for the proposed bioenergy supply and conversion facilities. The Grantee shall develop the conceptual and preliminary engineering designs and cost estimates for all required bioenergy facilities and compare the economics and risks to the present oil facility and to a coal option. The Grantee shall document proven fuel supply systems, fuel supply contracts, permits and licenses, financial, environmental, siting and management requirements. The Grantee shall seek to demonstrate that the proposed energy fuel is a reliable, cost-effective substitute for coal and oil at the W.R. Grace mine. More specifically, the Grantee shall perform the following tasks that have been organized into a sequence of project milestones. The milestones have been organized to provide the most important information as early as possible so that the study can be terminated if the project does not appear feasible.

INDEX

A. Title Page

B. Abstract/Executive Summary

C. Table of Contents

D. Introduction

E. System Design

F. Economics

G. Grant Administration

H. Results and Conclusions

I. Slide Show Development

APPENDIX

A: Resource Assessment

B: Fuel System Cost Performance

C: Economics

210: Prepare comparative ecomonic and risk analyses for the energy options. Compare each energy option to the current oil base case. Use risk items deferred in Task #113.

Product: Revise and update comparative risk analyses.

A: Task Report Table of Contents

1. Introduction
2. Task Description
3. Energy Option System Descriptions
4. Define Economic Data for Each Energy Option
5. Define Risk Analysis Procedure
6. Define Base Line Oil Case
7. Define Variable Factors and Assumptions
8. Prepare Economic and Risk Analysis for Each Energy Option
9. Prepare Comparative Risk Analysis
10. Develop Conclusions and Recommendations

Task 210: Economic/Risk Analysis

1. Introduction

This economic analysis is the culmination of the milestone activities.

2. Purpose and Task Description

Prepare comparative economic and risk analyses for the energy options under final consideration. Compare each energy option to the current oil base case by updating and revising the preliminary economic analysis prepared in task 113, Milestone No. 1.

3. Energy Options under Final Consideration

Base Case - Current oil and electric power purchases from traditional suppliers

The investigation results have evolved to the two following energy options: (1) Wood Primary Fuel with coal as back-up and (2) coal as the primary fuel with wood as the back-up. In both cases, the existing oil/propane systems will be used for emergency use as may be needed to cover short-term fuel interruptions. This strategy provides alternative fuels, wood and coal, at a lower cost than oil. The purchasing strategy is to establish a market for waste materials rather than developing a fuel supply system in competition with oil.

For each of the two preceding energy options, two separate energy replacement areas in the mine were being considered: (1) Replacing oil with wood or coal to produce hot gas for the vermiculite dryer, and (2) constructing a cogeneration facility to provide hot gas for the dryer and electricity for the mine. The investigation data developed during Milestone No. 4 and conclusion of the staff is that only the dryer system is the most practical option to consider at this time. The combination of the purchase price of electric power from the local utility, the high capital cost for the cogeneration facility and the current soft market for vermiculite would not develop strong enough economic incentives for cogeneration. Since the dryer option was not as risky and the alternative fuel concept would be more acceptable because of its lower capital cost and ease of implementation, the concluding phase of the study concentrated on the dryer option only.

4. System Descriptions for Energy Options

Oil System - Refer to task 110, paragraph 3.0
Wood System - Refer to task 202
Coal System - Refer to task 202

5. Economic Assumptions

Oil Data - Refer to task 113, paragraph 4
Wood Data - Refer to task 202
Refer to task 203
Refer to task 204
Refer to task 206
Coal Data - Refer to task 202
Refer to task 203
Refer to task 204
Refer to task 206

6. Risk Analysis

From the risks as presented in Task 113 paragraph 5.0, the following major risk areas were considered to be significant to the decision making process for the final recommendations:

Oil	Wood	Coal
Resource Base		
Domestic & Foreign	Local renewable resources	Foreign

In all cases, the existing Canadian coal and local wood supplies are considered more than adequate to provide an inexhaustible energy supply base for the mining operation for decades to come.

Foreign Influence

Only wood supply has no foreign influence on the resource base.

Technology

Existing technology with proven operating histories is available for each option.

Labor

The primary local industry is the forest products industry. During the last decade, the forest products industry has experienced fluctuating market conditions resulting in unstable employment for local labor. This has created a very favorable environment to create a new industry to complement the historical forest products industry. The creation of an energy market utilizing excess labor during downturns in the traditional forest products market is very desirable. This is the characteristic of the waste wood market. Therefore, as long as there is a major forest products industry in the

Libby area, a labor force to harvest fuels will always be available when sawmills have reduced production.

Transportation

As truck transportation is the delivery system for each energy source, transportation would impact each energy source the same. Therefore, no significant transportation advantage is seen for any of the options.

Price Stability

In the current short-term energy market, oil is enjoying a stable pricing structure. This has tempered the immediate need to find a substitute for oil. The recent downturn in the forest products industry has created an apparent uncertainty for wood as a steady fuel supply. This condition actually creates a ceiling price for wood. In reality, during periods of sawmill wood shortages, the lower sawmill operations create a high unemployment rate. This labor force is available to recover forest residues. The maximum cost for forest residues is presented in Task 106. As forest residue is a manufactured speciality product, its cost will be higher than sawmill waste wood, which is a by-product. This whole economic system for wood fuel exists in the 100-mile vicinity of Libby, Montana. Within the cost ranges developed for wood, a very long-term stable pricing structure is foreseen.

Coal can be used to introduce another layer of competitive fuel to increase price stability. The study results show that Canadian coal can be secured at about the same cost as waste wood. However, without pricing competition from waste wood the long-term pricing for coal would be expected to increase to approach the price of oil. Therefore, it is necessary to have the capability to use both coal and wood to create a stable long-term pricing structure at a significant cost savings over oil.

Environmental

No barriers to the orderly development of the wood and coal energy systems were discovered. By complying with the established licensing and permitting processes, it will take approximately 3 to 6 months to secure all permits to construct and operate the proposed facility. The only unknown is the potential requirement to install and operate stack gas desulfurization equipment when coal is used. The very low sulfur content of the Canadian coal (0.3%) makes this requirement marginal. For the dryer-only facility, it is unlikely that desulfurization equipment would be required because of the small annual quantities of coal consumed. The cogeneration installation will be marginal due to the lower sulfur content of the Canadian coal.

Capital

The major risk to any new capital expenditure would appear to be the stability of the demand for the mine product - vermiculite. If the five year market forecast looks stable, then the capital risk would be acceptable. The financial analysis, assuming current mine production levels, indicates that the savings in fuel costs would pay for the installation in less than two years without tax incentives.

Operations

The plant operating staff will easily become familiar with the use of the new fuels and burning equipment. No additional mine operating staff are foreseen. Training will be required for staff directly involved with the operation of the fuel burning equipment.

Maintenance

The maintenance program for the mine will have to include maintenance on the fuel handling conveyors, feeders and storage equipment. This additional maintenance will not make a significant impact on the existing mine maintenance work load.

6. Comparative Economic Analysis

This comparative analysis represents the results of the study. The alternative energy supply systems have been narrowed to the following configurations for the dryer operation only:

(1) Base Case: Existing oil fueled system
(2) Wood Primary Fuel/Coal secondary fuel
(3) Coal Primary Fuel/Wood secondary fuel

In order to develop wood in its most competitive position, it will be assumed that all wood fuel would be delivered fully prepared for use at the mine. This means that the mill waste wood would have to be hogged at the sawmill before loading into trailers for transport to the mine storage system.

The following summarizes the economic data developed through out this report. This data is broken down into its component parts so a long range economic forecast could be made. The long range economic forecast was included in the 15-year financial analysis prepared in Task 206. The conclusions are shown below.

Because the economic cost structures of waste wood and coal are similar, the price of waste wood delivered has to be $9.50 per ton to meet the price of coal. Negotiations between W.R. Grace and Rayson Brothers would determine the price of wood fuel. In addition, wood has certain tax advantages when a third party gasification system is utilized. These tax advantages would be shared, and the price of wood would be reflected in the price of the delivered gas.

	Oil Primary Fuel	Wood Primary Fuel	Coal Primary Fuel
Fuel Quantity Required	552,930 gal.	12,000 tons	5300 tons
Heat Content	120,000 Btu/gal	4,500 Btu/lb	8000 Btu/ton
Comodity Price (FOB Mine)	$0.664/gal	$9.50/ton (206)	$15.46/ton
Cost per Million BTU	$5.53	$1.056	$ 0.966
Annual Fuel Cost* (FOB Mine)	$367,080	$114,000	$87,238

	Oil	Wood	Coal
Energy Conversion Facilities			
Capital	Base	$700,000	$700,000
Annual Capital Recovery 10 yrs @20%	Base	167,000	167,000
Annual Maintenance 1% + Capital	Base	7,000	7,000
Annual Operating 50 hp @ $.05 3600 hr	Base	5,364	5,364
*Annual Subtotal	(Base)	(179,364)	(179,364)
TOTAL ANNUAL FUEL COST	$367,000	$387,974	$355,912
Equivalant Oil Price	$0.664/gal	$0.702/gal	$0.644/gal
Potential Tax Incentives	None	Yes Refer to Task 206. @ $0.68/MBTU $26,000/yr.	None

Task No. 211 - Deleted From Scope of Work

212: Phase II Management Review - Major Milestone: Prepare results and conclusions to date. Review with key project participants and prepare a formal presentation to the W.R. Grace & Co. management. The objective is: (1) to demonstrate beyond any reasonable doubt that the proposed bioenergy fuel is a cost-effective, reliable substitute for coal and oil, and (2) to secure approval of W.R. Grace & Co. and other parties identified to complete the final phase (Phase III).

Product: Phase II project development report. Approvals of key participants to complete Phase III.

A: Task Report Table of Contents

1. Introduction
2. Task Description
3. Executive Summary
4. Results and Conclusions
5. Task 201 thru 210 Summaries
6. Phase III Development Plan

B: Prepare Formal Presentations

1. Conduct Key Project Participants Review
2. Prepare Formal Presentation For W.R. Grace

Phase II Management Review

212.1 Introduction

During the last decade, the basic cost of energy to produce vermiculite from the W. R. Grace & Co. mine in Libby, Montana has increased faster than other elements of the product production costs. This study looks at waste wood and coal as an alternative to the mine's existing oil and electrical energy suppliers. Waste wood was selected because it is available as a by-product of the long-time, well-established local forest products industry in Western Montana, Northern Idaho and near-by Canadian sawmill operations. In the last decade, two major metallargical coal mines were opened in Canada 110 miles north of Libby. Waste coal from these operations is available in huge quantities, is a logical alternative to oil and would be competition for waste wood as an energy source.

The objective of this study is to develop the foundation and back-up information to enable Rayson Brothers Logging Company to enter into a long-term energy supply contract with W.R. Grace & Co.

To fund this preparatory effort, Rayson Brothers Logging Company secured a matching funds grant from the State of Montana and Bonneville Power Administration. This work began in May of 1984 and was completed in May of 1985.

212.2 Task Description: Phase II Management Review

Prepare results and conclusions. Review with key project participants and prepare a formal presentation to the W.R. Grace & Co. management. The objective is to demonstrate beyond any doubt that the proposed bioenergy fuel is a cost-effective reliable substitute for coal and oil.

212.3 Executive Summary

Wood and coal energy are the clear choice over existing oil energy for the vermiculite drying operation. However, it is still cheaper to purchase electricity from the local utility than generating electricity using either wood or coal fuels. All the investigations demonstrated that the W.R. Grace Mine energy requirements were a small percentage of the total reserves available for both wood and coal. In both cases, the energy reserves exceeded 100 years. Both coal and wood can be delivered at the same cost. Wood has the advantage of being entirely locally produced with no foreign influences on its availability. Coal, however, would require that a competitive alternative fuel be available; otherwise, the long term price of coal would approach the next alternative energy price, oil. Thus a wood fuel supply system is necessary to assume the long-term economic benefits. No environmental barriers were discovered that would preclude the orderly development of the project. Coal has the potential liability of requiring desulfurization equipment, and this cannot be determined until the actual project permit application has been turned in to the State. Blending coal and wood has proven beneficial to the combustion of both coal and wood fuels. This is an important operating benefit to using both fuels as an alternative to the other in event of any fuel shortages. Short-term shortages or interruptions should be met with existing oil and propane capabilities. From an operating viewpoint, wood and coal fuels present no operational problems. Existing technology exists to burn oil, coal and wood fuels in any combination.

The utilization of wood fuel requires the use of a gasifier (again will established technology) produced by a third party (Rayson Brothers Logging Company) to secure tax credits. The tax credits enable lower cost financing along with Industrial Development Bonds for the debt portion of the project capital structure. The tax law requires that the gas producing entity be independent of the user to qualify for tax credits. Rayson Brothers would enter into a 15 year energy supply contract with W. R. Grace & Co. to supply low BTU gas. The preceding business structure allows waste wood to be competitive with coal.

Rayson Brothers Logging Company proposes to install a gasifier adjacent to the vermiculite dryer. Rayson Brothers will be responsible for the wood fuel supply and would use coal as an alternative fuel for long-term fuel shortages. Low BTU gas would be sold on a long-term contract to W.R. Grace & Company at a price to cover Rayson Brothers costs and a reasonable profit. This price would be negotiated and would be tailored to provide for project financing and the inclusion of tax incentives. Rayson Brothers would like to initiate contract negotiations as soon as possible to provide for operation in the next 12 months.

212.4 Results and Conclusions: Dryer Only

	Wood	Coal
Fuel Requirements	12,000 tons/year	5,300 tons/year
Fuel Reserves Available	313,000 tons/year	500,000 tons/year
	produced in area	produced at mines
Fuel Cost (FOB Libby)	$9.50/ton	$15.46/ton
cost per million Btu	$1.056	$ 0.966
(oil cost-$587,000 @ $5.53/MMBTU)	$114,000	$81,938

	Wood	Coal
Technology	Fluidized Bed Gasifier (Existing technology)	Fluidized Bed Gasifier
Environmental	Meets all requirements	Meets all requirements (Potential addition of sulfur collection equipment)
Financing	Rayson Brothers or Third Party	W.R. Grace & Co.

Task No: 213: Report Preparation

Task Management Information

Libby Bioenergy Project

Activity Schedule

Task Start Date: January 1, 1985
Task Completion Date: January 31, 1985

Personnel Working on Task

	Name	Company	Phone No
Task Leader			
	Dave Van Hersett	RDA	509-838-8024
	Jerrie Little	RDA	509-838-8024

Prime Contractor			
	Clayton Rayson	Rayson Bros. Logging	406-293-9306
Project Manager			
	Dave Van Hersett	Resource Dev. Assoc	509-838-8024

TITLE PAGE

1. Grantee

Rayson Brothers Logging Company
Route 1, Box 886
Libby, Montana 59923
406/293-9306

2. Project Consultant:

David G. Van Hersett, P.E.
Resource Development Associates
West 601 Main Avenue, Suite 305
Spokane, WA 99201
509/838-8024

3. Location of Project:

Libby, Montana

4. Funding:

Total Project Cost:	$2,421,510
Amount of Grant:	$ 116,000

5. Project Scope:

The Grantee shall investigate, design and document the feasibility of using forest residue in the vicinity of Libby, Montana to replace oil and coal as a long-term, cost-effective, dependable energy supply for the vermiculite drying operation at the W.R. Grace and Company vermiculite mine. The Grantee shall research and document basic information including, but not limited to a site specific data base of wood resources, recovery and combustion technology data, environmental and economic constraints, instructional barriers and interfaces, and the development of specific guidelines for facility sizing for the proposed bioenergy supply and conversion facilities. The Grantee shall develop the conceptual and preliminary engineering designs and cost estimates for all required bioenergy facilities and compare the economics and risks to the present oil facility and to a coal option. The Grantee shall document proven fuel supply systems, fuel supply contracts, permits and licenses, financial, environmental, siting and management requirements. The Grantee shall seek to demonstrate that the proposed energy fuel is a reliable, cost-effective substitute for coal and oil at the W.R. Grace mine. More specifically the grantee shall perform the following tasks that have been organized into a sequence of project milestones. The milestones have been organized to provide the most important information as early as possible so that the study can be terminated if the project does not appear feasible.

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APPENDIX A: MILESTONE NO. 1 AND NO. 2 REPORT (TASKS 100 TO 114)

INTRODUCTION

Milestone No. 1 and No. 2 were divided into fifteen separate tasks to provide work packages based on the required manpower requirements. Each task was documented in an individual report. These individual reports were then used to develop the project conclusions and recommendations. Additionally, these individual tasks were used to manage the conduct and progress of the work. The following is a listing of the individual tasks for the Milestone No. 1 and No. 2 report:

100	Forest Residue Resources
101	15-Year Plan
102	Residue Rights
103	Residue Recovery System
104	Mine Energy Requirements
105	Conceptual Facility Design
106	Bioenergy Economics
107	Coal System
108	Coal Facilities
109	Coal Economics
110	Oil Economics
111	Environmental Assessment
112	Institutional Interface
113	Comparative Economics
114	Management Review

TASK 100: FOREST RESIDUE RESOURCES

1. INTRODUCTION

The W.R. Grace & Company vermiculite mine near Libby, Montana is located in the center of the 100 mile by 75 mile Kootenai National Forest. Eighty percent of the timber stands are public owned and 20 percent are private timber stands. The objective of the Libby Bioenergy Project is to utilize forest residues that are not used for commercial purposes. The U.S. Forest Service agreed to assist in developing data to determine the potential unused bioenergy resources recoverable from the Kootenai National Forest. A consulting forester, Charles Keegan, was contracted by Rayson Brothers Logging Company to prepare, evaluate and document recoverable forest residues by working with the Forest Service staff.

2. PURPOSE AND TASK DESCRIPTION

The objective of Task 100 is to establish the general magnitude of the forest residue resource in the supply area surrounding the W.R. Grace & Company plant in Lincoln County, Montana. The supply area examined includes the Kootenai National Forests and intermingled private and other public ownerships. The Kootenai National Forest, which supplies in excess of two-thirds of the timber cut in the supply regions will be considered the primary source of forest residue.

Forest residue will be dealt with in the following categories:

1. Logging residue which is dead and cull green material including tops, limbs and submerchantable stems that will become available on sites scheduled for logging and can be harvested in conjuction with conventional sawtimber harvesing operations;

2. Submerchantable material cut in timber stand improvement practices such as thinnings or stand conversion operations; and

3. All other forest residue which will include residual material from past years' logging operations and dead and cull green material on sites not scheduled for sawtimber harvesting operations or other land management treatments.

The major emphasis will be on logging residue and residue from stand conversion operations.

The volumes developed in Task 100 are gross volume estimates. That is, they will reflect volumes available annually for the next 15 years before cost of removal and delivery are considered. Proportions of this material available at a cost which might make it economically recoverable will be dealt within subsequent tasks.

3. TASK 100 PRODUCTS

The estimated volumes of forest residue potentially available annually for the next 15 years by ranger district are indicated in Table 100-1. The area is also displayed on the attached map. The annual available volumes, 1.8 million green tons, would certainly be more than sufficient to supply the estimated 25 to 100 thousand green tons per year required by W.R. Grace & Co. if it were available at a reasonable cost.

TABLE 100-1

GENERAL ASSESSMENT
ESTIMATED SUPPLY
FOREST RESIDUE
LIBBY, MONTANA AREA
VOLUMES AVAILABLE ANNUALLY
THOUSAND GREEN TONS
1985-1990

Kootenai National Forest By Ranger District	Logging Residue	Stand Conversion Residue	Total[1]
Rexford (D-1)	138	19	157
Yaak (D-2)	216	58	274
Fortine (D-3)	138	2	140
Troy (D-4)	94	1	95
Libby (D-5)	119	49	178
Fisher (D-6)	215	8	223
Cabinet (D-7)	135	36	171
TOTAL N.F.	1,055	183	1,238
Other Ownerships	539	61	600
Total All Ownerships	1,594	244	1,838

---

(1) The other componenets of forest residue would significantly increase this total. The other components are not readily available in large volumes and/or would be much more expensive to recover. Therefore, they have not been included.

4. DEVELOPMENT OF THE VOLUME ESTIMATES

Logging residue estimates in Table 100-1 include all wood fiber material left on logging sites annually in Lincoln County. This is defined as:

1. Cull logs and the bole portions of cull trees;

2. Submerchantable stems; and

3. Crowns and tops of trees.

Components 1 and 2 were developed from a recent inventory of logged-over lands conducted by the Bureau of Business and Economic Research, University of Montana, Missoula, Montana. Component 3 was developed from National Forest inventory data. These volumes of residue available in the Libby, Montana area are discussed further in "Forest Residue Available in the Libby, Montana Area", available through the Bureau of Business and Economic Research, University of Montana, Missoula, Montana.

Estimates of stand conversion residue volumes were developed from acres in need of conversion obtained from the Kootenai National Forest and an inventory of state and private timberlands in the area conducted by the Montana Division of Forestry and the U.S. Forest Service. Based on Forest Service estimates, forty green tons per acre should be available on these sites. It was assumed the area would be converted over a 15 year period. Total acres in need of treatment were, therefore, multiplied by forty green tons to yield estimates of total volumes available and then divided by 15 to estimate volumes available annually.

STAND CONVERSION

(M GREEN TONS {2.5 GREEN TONS PER BDU})

Kootenai N.F. By Ranger District	Total Available		15 Year Liquidation Annual Available
D-1	281/15 Years	=	19
D-2	866		58
D-3	40		2
D-4	24		1
D-5	878		59
D-6	113		8
D-7	536		36
	2,738		183
ALL OTHER	920		61
TOTAL	3,658/15	=	244

Note: BDU is a Bone Dry Unit of wood weighing 2,400 pounds of zero moisture wood.

KNF STAGNATED LODGEPOLE PINE STANDS

Kootenai NF By Ranger District	Acres (Reg)	M Green Tons	Acres (Unreg)	Total Acres
D-1	7,051	281(2,3)	1,885	8,936
D-2 (1)	21,640	866	3,760	25,400
D-3	995	40	40	1,035
D-4	600	24	35	635
D-5	21,940	878	10,060	32,000
D-6	2,830	113	370	3,200
D-7	13,404	536	13,204	26,608
TOTAL	68,460	2,738	29,354	
			Total	97,814

(1) Also have approx. 25,000 acres more that might have some commercial value. This was not added because the other districts included many of this type of stands.

(2) Assume 40 green tons per acre - 16 BDUs per acre

(3) 2.5 green tons per BDU

LOGGING RESIDUE
W. R. GRACE PROJECT
PROJECTED NET RESIDUE VOLUMES
W. R. GRACE SUPPLY ZONE
INCLUDES ALL LOGGING RESIDUE & CROWNS

	Harvest MMBF	Conversion Factor Logging Residue	Cunits Logging Residue	Conversion Factor Crowns	Cunits Crowns	Cunits Total Volume Residue	Total Thousands Green Tons
KOOTENAI N.F.							
Cabinet	28		30,240	849	23,772	54,012	135
Clearcut	26	1,110	28,860				
Lodgepole	2	690	1,380				
Fisher River	50		43,620	840	42,450	86,070	215
Clearcut	11	1,110	12,210				
Partial	15	990	14,850				
Lodgepole	24	690	16,560				
Fortine	30		29,700	849	25,470	55,170	138
Clearcut	15	1,110	16,650				
Partial	9	990	8,910				
Lodgepole	6	690	4,140				
Libby	25		26,250	849	21,225	47,475	119
Clearcut	15	1,110	16,650				
Partial	9	990	8,910				
Lodgepole	1	690	690				
Rexford	32		28,200	849	27,168	55,368	138
Clearcut	11	1,110	12,210				
Partial	5	990	4,950				
Lodgepole	16	690	11,040				
Troy	20		20,700	849	16,980	37,680	94
Clearcut	10	1,110	11,100				
Partial	9	990	8,910				
Lodgepole	1	690	690				
Yaak	50		44,160	849	19,527	58,347	146
Clearcut	18	1,110	19,980				
Partial	7	990	6,930				
Lodgepole	25	690	17,250				

	Harvest MMBF	Conversion Factor Logging Residue	Cunits Logging Residue	Conversion Factor Crowns	Cunits Crowns	Cunits Total Volume Residue	Total Thousands Green Tons
NON-INDUSTRIAL AND OTHER PUBLIC	23	1,340	38,820	849	19,527	58,347	146
INDUSTRIAL							
<50 miles to Libby	58	1,340	77,720	849	49,242	126,962	316
>50 miles to Libby	14	1,340	18,760	849	11,886	11,886	77
TOTAL VOLUME	330	---	358,170		280,170	638,340	1,594

PROJECTED TIMBER HARVEST CHARACTERISTICS
W. R. GRACE SUPPLY ZONE

	Annual Timber Harvest (MMBF)	- - - Logging System - - -			-Cutting Method-		- - - - - Volume By Station - - - - -			
		Volume Tractor	Volume Ground Lead	Volume Skyline	Clearcut Seed Tree	Partial	Clearcut Seed Tree	Partial	Lodgepole	Private
KOOTENAI N.F.	235									
Cabinet R.D.	28	9	1	18	26	2	26	--	2	--
Fisher River R.D.	50	37	5	8	35	15	11	15	24	--
Fortine R.D.	30	26	2	2	21	9	15	9	6	--
Libby R.D.	25	9	8	8	16	9	15	9	1	--
Rexford R.D.	32	24	7	1	27	5	11	5	16	--
Troy R.D.	20	8	2	10	10	10	10	9	1	--
Yaak R.D.	50	37	10	3	42	8	18	7	25	--
NON-INDUSTRIAL, PRIVATE & OTHER PUBLIC	23	19	2	2	N/A	N/A	---	--	--	23
INDUSTRIAL, PRIVATE										
Less than 50 miles	58	53	2	3	N/A	N/A	---	--	--	58
Greater than 50 miles	14	12	1	1	N/A	N/A	---	---	--	14
TOTAL	330	234	40	56	N/A	N/A	106	54	75	95

Source: Developed from U.S.F.S. timber harvest plans

HARVEST ESTIMATES WITHIN W. R. GRACE SUPPLY ZONE

Ownership	Timber Harvest (MMBF)	% of Total
A. Kootenai N.F.	235(1)	71
Cabinet R.D.	28	8
Fisher River R.D.	50	15
Fortine R.D.	30	9
Libby R.D.	25	8
Rexford R.D.	32	10
Troy R.D.	20	6
Yaak R.D.	50	15
B. Non-industrial Provate and Other Public Lands	23	7
C. Industrial Private		
Less than 50 miles to Libby	58	18
Greater than 50 miles to Libby	14	4
TOTAL HARVEST WITHIN W.R. GRACE SUPPLY ZONE	330	100%

Note: Recent changes to the Kootenai N.R. Forest Plan indicate that this total annual timber sell volume should be in the range of 215 to 220 MMBF rather than 235 MMBF.

CROWN VOLUME CALCULATIONS FOR STANDING TREES PER THOUSAND BOARD FEET SCRIBNER OF SAWTIMBER HARVESTED STANDING TREES (DIAMETER CLASS) ALL FOREST TYPES

Average Diameter	Stems/MBF Harvested	Average Crown Volume Per Tree	Total Crown Volume MBF (Ft^3)
4	7.4	0.8	5.9
6	5.3	1.6	8.5
8	4.4	2.8	12.3
11	5.6	5.3	29.7
17	2.3	12.4	28.5
			84.9

Note: 84.9 ft^3 of crowns per MBF of sawtimber harvested equates to 849 units per million scribner of sawtimber harvested.

Sources: Derived from Brown et al. Handbook for Predicting Slash Weight of Western Conifers, General Technical Report USFS INT-37, 1977 and James Faurot Estimating Merchantable Volume and Stem Residue in Four Timber species USFS Research Paper INF 196, AT.

TASK 101: STAND CONVERSION RESIDUE AVAILABILITY

Large volumes of stagnant lodgepole pine stands exist in the supply area. Based on U.S. Forest Service data, over 75,000 acres of lodgepole pine stands in need of conversion exist in the Kootenai National Forest (Table 101A). At present, virtually no market exists for this material, and much of it would be available to users free, or at a nominal stumpage fee.

The material is small in size, generally under 6 inches in diameter at breast height (DBH) and can be harvested economically generally using only small mechanical felling and bunching equipment. This equipment can generally operate efficiently on slopes under 20 percent. Further, some of these acres are not and will not be roaded in the next two decades and some portions will not be converted because their existence protects other resource values. Kootenai National Forest personnel have identified the number of acres of stagnated stands by ranger district, roaded, on slopes under twenty percent, and otherwise available for treatment (Table 101-A-1).

These constraints considerably reduce the acreage and total volumes available. As indicated in Table 101-A-1, only an estimated 1,749 national forest acres and 583 acres from other ownerships are available from roaded sites with slopes under twenty percent. Conversion of these stands would yield an estimated 93,000 green tons total. This would supply a user with approximately 6,000 green tons per year given a 15-year liquidation period (Table 101-A-2).

Inclusion of material on slopes up to 40 percent would more than triple the acreages and volumes available to an estimated 300 thousand green tons. However, mechanical fellers and bunchers capable of operating on slopes up to 40 percent are expensive. Timber with an average DBH less than 6 inches is very costly to harvest with these larger machines. Because of the different equipment necessary to operate on steeper slopes, separate cost estimates should be made for material from slopes over and under 20 percent.

OTHER COMPONENETS OF FOREST RESIDUE

The discussion of other components of forest residue in this report has been developed from "Forest Residue Recovery: Available Volumes and Cost", C. E. Keegan, T. J. Jackson, Bureau of Business and Economic Research, University of Montana, Missoula, Montana, 1984.

Logging Residue Availability and Cost

Logging residue availability in the Libby, Montana area was evaluated based on four recovery systems. These were: (1) relogging recently logged areas, (2) log-length residue recovery at the time of sawtimber harvest to recover in log-length, large cull trees and cull portions of sawtimber trees, (3) processing whole trees at the logging site to recover tops and crowns of sawtimber trees and submerchantable stems, and (4) hauling whole trees (sawtimber and submerchantable stems) to the mill site at which the sawtimber is to be processed.

SUMMARY OF STAGNATED LODGEPOLE ACRES
BY DISTRICT, ACCESS AND SLOPE CLASS

arvest Type, Slope-Access	DISTRICTS Rexford	Yaak	Fortine	Troy	Libby	Fisher River	Cabinet	Total
Regulated								
Roaded, 0-20% (1-A)	0	503	79	0	1,120	0	0	1,693
Roaded, 21-40% (1-B)	357	1,337	248	90	1,093	244	311	3,680
Roaded, 41-55% (1-C)	1,981	3,434	280	0	2,445	246	1,515	9,901
Roaded, 55% + (1-D)	640	2,634	19	500	7,126	509	3,168	14,596
Unregulated								
Roaded, 0-20% (2-A)	0	36	0	0	0	0	20	56
Roaded, 21-40% (2-B)	0	0	0	0	0	0	141	141
Roaded, 41-55% (2-C)	0	0	0	0	600	0	60	660
Roaded, 55% + (2-D)	0	160	0	0	725	0	1,500	2,385
Regulated								
Unroaded, 0-20% (3-A)	0	366	60	0	402	118	70	1,016
Unroaded, 0-20% (3-B)	1,507	2,933	294	0	796	396	190	6,116
Unroaded, 0-20% (3-C)	1,881	3,224	174	0	1,302	266	1,524	8,371
Unroaded, 0-20% (3-D)	750	6,953	103	0	8,221	1,023	6,042	23,092
Unregulated								
Unroaded, 0-20% (4-A)	0	0	0	0	0	0	0	0
Unroaded, 0-20% (4-B)	0	0	0	0	30	0	0	30
Unroaded, 0-20% (4-C)	0	0	0	0	280	188	289	757
Unroaded, 0-20% (4-D)	74	0	0	0	640	0	1,839	2,553
TOTAL	7,190	21,580	1,248	590	24,780	2,990	16,669	75,047

TABLE 101-A-1

SUMMARY VOLUMES STAND CONVERSION RESIDUE
LIBBY, MONTANA AREA
KOOTENAI NATIONAL FOREST AND OTHER OWNERSHIPS
FOR SITES WITH SLOPE UNDER 20 PERCENT ON ROADED SITES
THOUSAND GREEN TONS

Ranger District	Acres	Volume/Acre	Total Available Volume
Rexford	--	40	---
Yaak	539	40	21,560
Fortine	70	40	2,800
Troy	--	40	---
Libby	1,120	40	44,800
Fisher River	--	40	---
Cabinet	20	40	800
Total Kootenai	1,749	40	69,960
Other Ownerships	583	40	23,320
TOTAL	2,332		93,280

Note: The data on stand conversion residue in the Kootenai National Forest were developed by Jerrold Park and Kenneth Briggeman, timber staff, Kootenai National Forest. The information on acres available from other ownerships was estimated from an inventory of state and private lands conducted by the Montana Division of Forestry and the U.S. Forest Service.

TABLE 101-A-2

SUMMARY VOLUMES, STAND CONVERSION RESIDUE
LIBBY, MONTANA AREA
KOOTENAI NATIONAL FOREST AND OTHER OWNERSHIPS
AVAILABLE ANNUALLY ON ROADED SITES, SLOPE UNDER 20 PERCENT
THOUSAND GREEN TONS
1985-1999

Ranger District	Acres	Volume/ Acre	Liquidation Period	Total Annual Available Volume
Rexford	--	40	15 years	---
Yaak	539	40	15 years	1,437
Fortine	70	40	15 years	187
Troy	--	40	15 years	---
Libby	1,120	40	15 years	2,987
Fisher River	--	40	15 years	---
Cabinet	20	40	15 years	53
Total Kootenai	1,749	40	15 years	4,664
Other Ownerships	583	40	15 years	1,555
TOTAL	2,332			6,219

Note: The data on stand conversion residue in the Kootenai National Forest were developed by Jerrold Park and Kenneth Briggeman, timber staff, Kootenai National Forest. The information on acres available from other ownerships was estimated from an inventory of state and private lands conducted by the Montana Division of Forestry and the U.S. Forest Service.

Table 101-A-3 indicates the estimated volumes of logging residue available annually based on the four residue recovery approaches in the supply zone. The volumes available through the various systems are not necessarily cummulative, but they are also not necessarily mutually exclusive. For example, the iniciation of a log-length system on all sites in the supply area would remove the material indicated in the relog system. On the other hand, if a whole tree recovery system was undertaken on suitable sites, a log-length system was undertaken on suitable sites, a log-length system could at least be employed on sites not suitable for whole tree systems. A log-length system could, of course, be attempted on sites in which whole tree recovery was taking place. Because of the nature of stands conducive to whole tree logging, little, if any, additional material should be available in the form of cull dead trees or cull portions of sawtimber trees on these sites.

Choices of a Recovery System

Whole Tree Systems. Users in the Libby, Montana area desiring fuel for industrial plants or electrical generation would find material available in whole tree recovery systems the lowest cost forest residue. Specifically, tops and crowns of sawtimber trees would be the least expensive residue material available. This source would not be suitable for many uses such as pulp and paper or most reconstituted board products. A user, therefore, should face very little competition for the component. Mills in the area receiving sawtimber would probably find whole tree hauling the cheapest source of wood fiber. A large volume user independent of a sawmill or a plywood plant might find contracting for in-woods processing of whole trees a cheaper system. In either case, cost estimates would range from $10 to $25 per green ton with a suggested average of $20 per green ton in 1984 dollars, excluding profit and risk for the operator.

Log-Length Recovery in Conjunction with the Sawtimber Harvest:

A log-length recovery system to capture large cull trees and cull portions of the sawtimber trees appears to offer some potential. Small additional volumes may be available relatively inexpensively if cull portions of sawtimber trees only are recovered. Estimates are that for the entire area, an additional 65,000 green tons in the form of cull portions of sawtimber trees would be available annually.

Volumes of large sound cull trees remaining on sites to be tractor logged would be somewhat more expensive than tops and limbs of sawtimber trees.

Relogging: The estimated costs of relogging sites, in excess of $35 per green ton in 1984 dollars, are so high they preclude this system as a reasonable source for almost any potential high volume user. Low volume users such as home fuelwood dealers or small volume cedar products loggers may find recently logged sites on which they can recover material much more cheaply than $35 per green ton. Given the characteristics of the residue identified in the inventory, it appears even these opportunities are limited.

Precommercial Thinning Operations

Based on discussions with land managers in the area, mechanized felling and bunching would not be allowed on many of the sites scheduled for thinning. Because hand felling and bunching would be extremely expensive (in excess of $35 per green ton chipped and delivered), this component was not viewed as a viable source of wood fiber to a user of even moderate size (10,000 to 25,000 green tons per year).

Slash from Previous Logging Operations

In addition to wood fiber from recently completed logging operations, wood residue is available in the form of untreated or improperly treated slash from logging operations completed in the last 10 to 15 years. In the mid-1970's, untreated slash in the Northern Region represented a very large volume of material. Regional office personnel feel that since the mid-1970's, slash treatment has kept pace with harvesting operations. Large volumes of untreated slash for more recent years would, therefore, not be available. The inventory of logged over lands completed as part of this project also indicates greatly improved slash disposal and treatment. Volumes of back-log slash that were available would be generally more expensive to recover than the cost per green ton estimated in the analysis of relogging recently logged lands. Backlog slash areas could not, therefore, be expected to contribute wood fiber to a potential user of any size.

Dead & Cull Green Material on Sites That Will Not be Logged for Sawtimber

The unit cost of a logging operation is very dependent on the volume per acre to be removed, generally decreasing as more volume per acre is removed. The selective logging of dead and cull green material would be more expensive than the harvesting of the same material in conjunction with a sawtimber harvesting operation in which much larger volumes per acre were harvested. Some selective logging of dead timber does occur in the northern Rocky Mountains especially for firewood and high value products such as house logs.

There is an enormous quantity of dead and cull green timber in the northern Rocky Mountains. However, much of it is not in proximity to roads. It is doubtful, therefore, that this source could supply a high volume user at a reasonable price.

TABLE 101-A-3

VOLUMES AND COST OF LOGGING RESIDUE AVAILABLE ANNUALLY THROUGH ALTERNATIVE RECOVERY SYSTEMS LIBBY, MONTANA SUPPLY ZONE 1986-1995

Residue Recovery System	Volume 000's Green Tons	Estimated Cost(1) (1984 Dollars)
Relog System(2)	138	\$36/green ton
Log-Length System(3)		
Tractor Ground	178	\$20/green ton
Cable Ground	61	\$50/green ton
Whole Tree Systems(4)		
In-Woods Processing	260(5)	\$14-26 green ton
Mill Site Processing	298(6)	\$10-24/green ton(7)
	83(8)	\$26/green ton
TOTAL ANNUAL	1,018	

Source: University of Montana, Bureau of Business and Economic Research, Libby, Montana Logging Residue Inventory (Missoula, Montana, 1984)

Notes:

(1) Costs do not include profit and risk.

(2) A relog residue recovery system involves logging sawtimber first, and then relogging the site for residue material normally left in the logging operation.

(3) A log-length system involves recoverying cull trees, logs and cull portions of sawtimber trees in conjunction with the sawtimber logging operation.

(4) Whole tree systems invlove recovering unmerchantable tops and crowns of sawtimber trees as well as crowns, tops and boles of submerchantable trees not part of sawtimber growing stock.

(5) Crowns and unmerchantable tops of sawtimber trees and whole submerchantable trees.

(6) Crowns and tops of sawtimber trees.

(7) Does not include additional haul cost if the wood fiber is not processed at the same mill at which the sawtimber is processed.

(8) Whole submerchantable trees.

TASK 102: RESIDUE RIGHTS

This section deals with the opportunities to secure rights to logging residue and residue from stagnant lodgepole pine stands in the supply area for the W.R. Grace and Company plant.

Both the Kootenai National Forest and the Montana Department of State Lands, Division of Forestry were contacted regarding rights to forest residue on lands under their control. Both have very similar situations in terms of securing rights to recover residue.

Logging Residue. The agencies were very supportive of projects to recover material now left on sites following logging. Rights to the residue would have to be obtained through the purchaser of the timber and must be approved by the agency. Generally, slash disposal represents a cost to the timber purchaser, and the purchaser should be willing to arrange for its recovery given the user was willing to pay removal costs. The arrangement for removal must be approved by the agency involved, but both indicated a willingness to approve logging residue removal as long as the objectives for slash disposal and other post logging treatments were met. A more detailed discussion of opportunities to obtain rights to logging forest residue and other components of forest residue on National Forest lands is contained in the attachment developed by K.A. Briggeman, the Timber Management Officer on the Kootenai National Forest. The contact with the Montana Division of Forestry was Paul Moore, Utilization Specialist for the state located in Missoula, Montana.

Rights to recover logging residue on private lands would have to be developed through negotiations with individual private landowners in the region. However, since disposal or treatment of logging residue represents an expense to the landowner, private owners in general would be expected to agree to recovery arrangements which reduced or eliminated the cost of slash disposal.

Stand Conversion Residue

The Kootenai National Forest has in excess of 75,000 acres of stagnant lodgepole pine stands in need of conversion to better stocked, more productive stands. At present, the forest is paying contractors to fell or slash and pile a portion of these acres annually. Forest officials do not feel they could commit to pay a contractor on a long-term basis to treat these sites by removing all or a portion of the residue.

The do feel long-term contracts to remove the residue from stagnant stands could be made available. They would have to be put up for bid with at least a small payment made to the forest for the residue. Given that no market of any size currently exists (and probably will not exist in the next 10 years) for this kind of residue in the area, contracts would certainly be available for a very minimal cost. For further details on recovery of residue for stagnant lodgepole pine stands, see the attachment from the Kootenai National Forest.

The situation from lands managed by the Montana Division of Forestry would be very similar to that for the Kootenai National Forest.

Rights to residue from stagnant stands or private lands in the area would have to be obtained from individual owners. Because these overstocked stands represent serious land management problems, private landowners in the area should be very amenable to a residue recovery proposal which puts these stands in a more productive situation.

TASK 103: FOREST RESIDUE RECOVERY SYSTEM

1. INTRODUCTION

The Rayson Family has been logging in the Libby area for 32 years. The traditional markets for the past ten years have made it difficult to stay in business because of the poor lumber markets and fluctuating chip market. To survive, Rayson Brothers Logging Company has been looking for new markets in the Libby area. These investigations concluded that we had to create a new market and develop new forest harvesting systems for our company to survive. The following is the initial phase of defining new forest harvesting techniques to produce a wood fuel in direct competition with fuel oil and coal in the Libby area.

2. PURPOSE AND TASK DESCRIPTION

The purpose of this task is to define the forest residue collection, preparation adn transportation system utilizing existing technology and provide proven cost data. Contact currently operating forest residue recovery operations, interview operators to determine equipment requirements, labor skills and training, productivity of equipment and labor and maintenance requirements. This data will be the basis to develop a recommendation as to how wood residue fuels can compete with oil and coal fuels to the satisfaction of W.R. Grace & Company.

3. GENERAL DESCRIPTION OF FOREST RESIDUE RECOVERY SYSTEM

The following diagram displays the forest residue recovery system process in cartoon form. The cost and system performance data prepared in this task is for a system to harvest stagnated lodgepole pine stands having an average stem diameter of 3 to 4 inches. These stands are located within a 60-mile haul distance of the W.R. Grace mine.

Two forest residue recovery systems were configured for the initial phase investigations. These two alternatives will be known as: (1) in-woods chipping, and (2) chip-at-plant. The in-woods chipping system is shown on the following process diagram. The system consists of filler-bunchers cutting trees and accumulating them in piles. A grapple skidder then grabs the pile and drags it to a landing. At the landing, the trees, limbs and all are fed to a portable chipper and blown into a waiting .chip van. The fuel chips are then hauled to a fuel storage pile at the W.R. Grace mine.

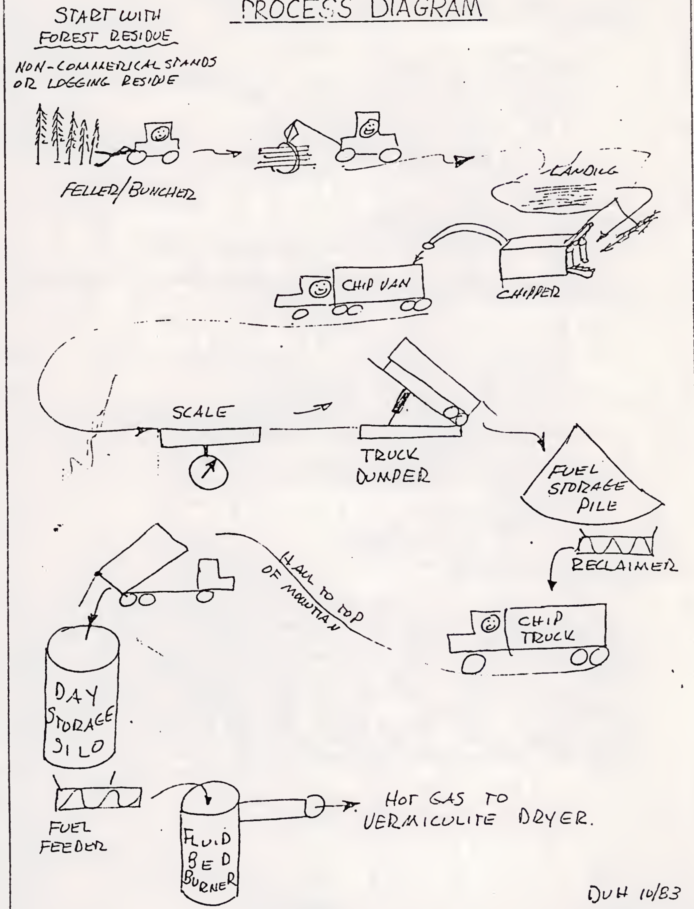
The chip-at-plant system locates the chipper at the fuel storage pile rather than in-the-woods. Whole trees are loaded onto logging trucks with special side rails and hauled to a central location for chipping.

4. EXISTING TECHNOLOGY

For this investigation, the Rayson Brothers would only consider proven forest harvesting equipment and then equipment that had existing dealers and maintenance/operating support history in the Libby area. This operating criteria was determined to be essential to develop a bioenergy fuel supply system in competition with oil and coal.

LIBBY BIOENERGY PROJECT

PROCESS DIAGRAM



DUH 10/83

5. DEFINITION OF FOREST RESIDUE COLLECTION, PREPARATION AND TRANSPORTATION SYSTEM

The in-woods chipping system was configured with the following equipment:

- John Deer 540B Grapple/Skidder
- Bobcat Feller Buncher
- John Deer 550 Crawler with Feller Buncher
- Morbark Model 20 Whole Tree Chipper
- John Deer 550 Crawler with Blade
- 1 Ton 4WD Crew Cab
- 3/4 Ton 4WD Standard Pick-up
- 1/2 Ton 4WD Standard Pick-up
- Chain Saws
- Maintenance Tools
- Parts/Supplies Inventory
- Office Equipment/Supplies
- Fuel chips will be hauled by contract haulers

The chipping at plant was configured with the following equipment:

- John Deer 540B Grapple/Skidder
- Bobcat Feller Buncher
- John Deer 550 Crawler with Feller Buncher
- Morbark Model 20 Whole Tree Chipper
- John Deer 550 Crawler with Blade
- John Deer Fork Lift to Unload Logging Trucks
- Morbark Three Wheel Grapple Skidder
- 1 Ton 4WD Crew Cab
- 3/4 Ton 4WD Standard Pick-up
- 1/2 Ton 4WD Standard Pick-up
- Chain Saw
- Maintenance Tools
- Parts/Supplies Inventory
- Office Equipment/Supplies

6. COST DATA SOURCES

In the Libby area, Simms Equipment Company of Bonners Ferry, Idaho has a long history of providing excellent maintenance and operating support to the logging industry. This company handles John Deere equipment and was contacted for pricing information. Morbark Industries, Inc. has a strong reputation for rugged equipment and good services. Their equipment representative, located in Lewiston, Idaho was contacted for pricing information. The primary sources of cost information were the interviews with other existing forest residue recovery operators. These interviews are reported in the next section.

7. OPERATING FOREST RESIDUE RECOVERY INTERVIEWS

The following are notes prepared by Clayton Rayson of the interviews of forest residue operations in teh Pacific Northwest.

INTERVIEW DATE: June 27, 1984
PERSON(S) INTERVIEWED: Jerry Parks & John Hodges, USFS
LOCATION: Noisy Creek Area Stagnated Lodgepole Stands

Block A was clear cut, the average diameter was about 3", and the material was approximately knee deep. Because of the high number of trees per acre and the wind factor, the trees were felled every direction of the compass, making it almost impossible to skid with a grapple skidder.

Block C was about the same diameter, only much thicker. After being clear cut, the material was approximately 4-5 feet deep in areas. The USFS required that some snags be left standing for birds and squirrels.

Meeting with regional officers and Yaak District rangers, we looked at a stagnated lodgepole stand in the Zulu Creek area. Several blocks in this area are set up for up-coming bids, totalling about 175-200 acres. The piece we looked at had a lot of small DBH material, but also several 6"-7" and 9"-10" trees. It was determined by the USFS that the saw and stud log material was not high enough for a logging contract, so they are contracting to brush pile without slashing.

It is my opinion that these types of stagnated lodgepole stands are ideal for our proposed operation.

I visited with the Yaak District Ranger, and he was very excited that we were interested in this type of stand. He said that the majority of stagnated lodgepole in his district was of the same nature as the Zulu area.

INTERVIEW DATE: June 28, 1984
PERSON(S) INTERVIEWED: Bob Savage
LOCATION: LP Sawmill & Wafer Wood Operation & Wood Operation, Chilco, Idaho (Phone: 208/772-6032)

LP uses a Makeri 33T for a large portion of their Chilco, Idaho Operation. They have two of these machines and are planning on purchasing two more.

The Makeri 33T snips up to a 10" diameter tree, limbs it and cuts the top out at 2". A good operator can cut anywhere from 400 to 600 pieces per 8 hour shift.

The machine is limited to fairly flat ground because of stability. The cost per machine is approximately $54,000.

Although it is a very maneuverable machine with high production, it would not satisfy our needs, as we will use limbs and tops. We need a machine that can operate on up to at least 25-30% grades of ground.

I have obtained the address of the Makeri Company and am sending for more information on their equipment lines.

INTERVIEW DATE: July 5, 1984
PERSON(S) INTERVIEWED: Gene Crismane (Phone: 503/963-9841)
LOCATION: LaGrande, Oregon

Gene Crismane has been chipping for pulp chips and fuel chips for a considerable time. I was told that when the pulp market was way down, he and Bob Hermanson were the only two still working in this part of the country.

Gene's operation in the woods consists of two feller bunchers (Bobcat & J.D. Cat with F.B), 2 JD 540B swinging grapple skidders and 1 Morbark 22 whole tree chipper. They chip in the woods and don't seem to have any problem with getting chip vans into their operation. I believe that this is because of the flatter ground in this part of the country. They also chip material at a plant in town. They have a hydraulic loader - debarker - whole tree chipper and fork lift at the plant in town. With this kind of an operation, they could buy chipping material, chip it themselves in the woods, or if not accessible with chip vans, haul whole logs to town plant and then chip.

Their feller bunchers harvest 800-1200 stems a day. With their woods operation, they harvest 10-12 loads a day chipped, or about 250-300 green tons a day.

They quoted us a price of $36-38 a bone dry unit, which is about $30 a green ton. This was the figure they gave us for harvesting 4" DBH material plus, up to 25% slope, delivered.

They are very optimistic about chipping operations in the future and also the ever increasing value of fuel chips in the future.

We did not get to see their woods operation on this tour, but are planning on flying down to see it on July 27.

INTERVIEW DATE: July 13, 1984
PERSON(S) INTERVIEWED: Bob Hermanson (Phone: 509/445-1131)
LOCATION: Usk, Washington

They buy logs delivered to the plant for:

12'6" & Longer - $16/ton
8'4" to 12'6" - $15/ton
8'4" to 16`6" - $28/cord
16'6" & Up - $30/cord

In their logging situation, utilizing 6" DBH material, they harvest 6-8 loads at 25 green tons a load.

They use a JD6903B feller buncher and 2 JC540-B swinging grapple skidders.

They do not chip in the woods. Bob had a lot of concern about getting chip vans in the woods and highly recommended that we check into this problem before continuing.

Their feller buncher can harvest anywhere from 600-1200 pieces per day. He didn't have anything good to say about the Bobcat feller buncher. In fact, they have one for sale.

They do all of their chipping at the plant site. Their cost for chipping alone is $6 to $7 a bone dry unit - providing the material is within a 25 mile radius.

Bob is very familiar with fuel chips, their costs of harvesting and their value. He said that the breakeven point on fuel chips and around $35 a bone dry unit.

I toured their chipping plant which consists of a Morbark 22 whole tree chipper, 2 debarkers and 2 fork lifts. They have a railroad siding, but haul most of their material in chip vnas. They have several extra vans which they can move around with a fifth wheel attachment that fits on the front of one of the fork lifts.

Montana three forest residue recovery operations were not selected for field interviews because these operations were not compatible in size to the operation envisioned for the Libby Bioenergy Project.

8. LABOR SKILLS AND TRAINING REQUIREMENTS

Based on the visits to the other operating forest residue recovery operations, the training requirements for our labor will be minimal. Most of the labor skills required are part of traditional logging operations that our firm uses. The only new skills required are those associated with the operation of the feller buncher and the chipper. All other pieces of equipment are in use by our labor force, and the maintenance practices are the same. It is reasonable that in a one month period, we would have learned 90% of the new skills to be efficient with the new recovery systems.

9. LABOR AND EQUIPMENT PRODUCTIVITY

For in-woods chipping, the production objective is to keep the in-woods portable chipper busy. Based on the type of forest stands to be harvested and the terrain, the optimum equipment configuration is one feller/buncher and one grapple skidder feeding one chipper. This will provide an average daily production rate of 80 green tons per day. Using a seven month period to be in the forest and one 4-man crew, the annual production rate would be approximately 12,000 tons per year. This production rate is higher than necessary to provide fuel for the W.R. Grace dryer operation.

10. MAINTENANCE REQUIREMENTS

The maintenance requirements for the proposed forest residue recovery equipment is the same as for our traditional logging machinery. The new skills required will be associated with the care, maintenance and sharpening of the snipper knife blades. The other maintenance of tractor-type equipment, hydraulic systems, tires, tractor tracks, normal diesel motors, etc. is established in our normal equipment operating and maintenance program.

11. OTHER DATA

In-woods chipping will require use of chip vans at the landing. This will require attention to road design to provide a longer turning radius for the chip vans. Chip vans do not track as well as the logging trucks. Thus, road contruction/modification provisions will be required in all contracts providing access to forest residue recovery sites.

12. MANUFACTURER BROCHURES AND COSTS

Manufacturer brochures are located at the end of this appendix. A brochure for each major equipment price is included for reference.

The following is a listing of the costs for each piece of equipment for each service. These costs were used in the preparation of the economic performance projections later in this report.

CHIPPING AT PLANT: OPTIMUM EQUIPMENT PERFORMANCE
(72,000 TONS/YEAR)

2 JD 540B G/S @ $101,000	$ 202,000	
1 BC F/B	80,000	
2 JD 550 Crawlers w/FB @ $94,000	188,000	
1 MB 22 WTC	138,000	
1 MB 20 WTC (Used)	65,000	
1 JD 540B G/S (Used)	60,000	
1 JD 550 Crawler Blade (Used)	40,000	
Sub total		$773,000
1 JD Forklift	150,000	
1 MB 3 Whl G/S	65,000	
Sub total		$998,000
1 1 Ton 4 WD Crew Cab	14,500	
1 3/4 Ton 4 WD P/U	11,800	
1 1/2 Ton 4 WD P/U	10,000	
2 Chain Saws @ $750	1,500	
1 Welder, Torch, Woods Tools	4,000	
1 HD Tool Set	3,500	
1 Parts/Supplies Inventory	5,000	
Sub total		$ 50,300
Office Equipment/Supplies	5,500	
TOTAL		$1,043,800

IN-WOODS CHIPPING: OPTIMUM EQUIPMENT PERFORMANCE
(72,000 TONS/YEAR)

2 JD 540B G/S @ $101,000	$ 202,000	
1 BC F/B	80,000	
2 JD 550 Crawlers w/FB @ $94,000	188,000	
1 MB 20 WTC	138,000	
1 MB 18/20 (Used)	65,000	
1 JD 540B G/S (Used)	60,000	
1 JD 550 Crawler Blade (Used)	40,000	
Sub total		$773,000
1 1 Ton 4 WD Crew Cab	14,500	
1 3/4 Ton 4 WD P/U	11,800	
1 1/2 Ton 4 WD P/U	10,000	
2 Chain Saws @ $750	1,500	
1 Welder, Torch, Woods Tools	4,000	
HD Tool Set	3,500	
Parts/Supplies Inventory	5,000	
Sub total		$50,300
Office Equipment/Supplies	5,500	
TOTAL		$ 828,800

CHIPPING AT PLANT: DRYER FUEL PRODUCTION
(12,000 TONS/YEAR)

1 MB #20 WTC (Used)	$ 82,800	
1 MB Fork Lift (Used)	49,500	
1 JD 550 Crawler/Blade (Used)	30,000	
1 1/2 Ton 4 WD P/U	10,000	
1 Chain Saw	750	
1 Welder Torch	2,500	
1 HD Tool Set Equipment	2,000	
1 Parts/Supply Inventory	1,500	
Sub total		$179,050
Office Equipment/Supplies	2,500	
TOTAL		$ 181,550

IN-WOODS CHIPPING: DRYER FUEL PRODUCTION
(12,000 TONS/YEAR)

1 JD 540B G/S (Used)	$ 60,500	
1 JD 555 F/B (Used)	56,400	
1 MB 18/20 WTC (Used)	82,800	
1 JD 550 Cat/Blade (Used)	30,000	
1 1 Ton 4 WD Crew Cab	14,500	
1 1/2 Ton 4 WD P/U	10,000	
2 Chain Saws @ 750	1,500	
1 Welder Torch	4,000	
1 HD Tool Set Equipment	3,500	
1 Parts/Supply Inventory	2,500	
Sub total		$ 265,700
Office Equipment/Supplies	3,500	
TOTAL		$ 269,200

GOAL: 12,000 Wet Tons - Drying

Consumption @ 50 weeks
5 days

250 days

@ 48 tons/day

Production @ 7 months (30 weeks)
5 days

150 days

@ 80 tons/day

LIST OF REFERENCES

Personnel participating in this task:

- Clayton Rayson, Rayson Brothers Logging Co.
- Sam Van Arsdale, Rayson Brothers Logging Co.
- Tom Peck, C.P.A.
- Robert Hermanson, Forest Enterprises, Inc.
- Harold Simms, Simms Equipment Co.
- Chuck Keegan, Forester
- Peter Johnson, Morbark of Idaho, Lewiston, Idaho 83501 (208/743-5501)
- Ken Briggeman, Jerry Parks, John Hodges, U.S. Forest Service S. O. Building, Libby, Montana 59923 (406/293-6211)
- Bob Savage, Louisiana-Pacific, Chilco, Idaho
- Gene Chrisman, Andy Monsey, LaGrande, Oregon

TASK 104: DOCUMENT W.R. GRACE MINE ENERGY REQUIREMENTS

1. INTRODUCTION

The W.R. Grace & Co. operates a vermiculite mine near Libby, Montana. The operation surface mines a large, unique vermiculite deposit with conventional front-end loaders loading into large dump trucks for transport to a near-by processing, cleaning and sizing plant. When cleaned, the product is dried, then hauled to a storage/shipping facility at the railroad siding. The mine uses traditional energy sources - electricity and fuel oil - to operate the facilities to produce a commercial grade of vermiculite.

In past years, the traditional stable energy supplies enjoyed a very stable cost structure. During the last decade, the world oil market influences and the impact of WPPSS nuclear projects have resulted in steadily rising energy costs for the mining operation.

2. PURPOSE AND TASK DESCRIPTION

The purpose of this task is to document the base energy requirements of the W.R. Grace mine. This data will be used to scope the potential for substituting alternative fuel sources for the existing energy sources used by the mine. The existing energy uses will be documented by fuel type, end use, annual consumption and annual energy cost. The energy requirements for mobile equipment will not be included.

3., 4., 5. MINE ENERGY USES

Item	Electric	Oil	Propane
Annual Consumption	34,000,000 KwH	885,000 Gal	Emergency Use Only
Annual Peak (High)	6,000 Kw		
(Low)	700-900 Kw		
Hourly Peak	6,000 Kw		
Steam Fuel (#5 oil)		315,000 Gal	
Dryer Fuel (#5 oil)		570,000 Gal	
Processing Plant			
Annual Use	20,000,000	252,000 Gal	
Monthly Use (High)		-0-	
(Low)		70,000 Gal (1)	
High Weekly Use		16,600 Gal (1)	
Average Hourly Use	3,333 Kw	70 Gal/Hr (1)	
Drying Facility			
Annual Use	3,500,000	570,000 Gal	
Monthly Use		47,500 Gal	
Typical Weekly Use		11,000 Gal	
Typical Hourly Use	583 Kw	158 Gal/Hr (1)	
Screening Facility			
Annual Use	10,000,000		
Monthly Use			
Typical Weekly Use			
Typical Hourly Use	1,667 Kw		
Maintenance Facility			
Annual Use	500,000	63,000 Gal	
Monthly Use		5,250 Gal	
Weekly Use		1,211 Gal	
Hourly Use Avg. (2)	57 Kw	7.2 Gal/Hr	

Operating Hours

(1) 24 hr. x 150 days = 3,600 Hr.
(2) 24 hr. x 365 days = 8,760 Hr.

STEAM USE CHARACTERISTICS

PROCESS STEAM FUEL 63,000 Gallons

Average Use = $\frac{63,000\text{ gallons}}{24\text{ hr.} \times 365\text{ days}}$ = 7.2 Gallons/hr.

HEATING STEAM FUEL (5 months) 252,000 Gallons

Average Use - $\frac{252,000\text{ Gallons}}{24\text{ hr.} \times 150\text{ days}}$ = 70 Gallons/hr.

MONTHLY USE

	Gallons Per Month		
	Process Steam	Heating Steam	Total
Summer	5,250 Gal	-	5,250 Gal
Winter (Peak)	5,250 Gal	70,000	72,250 Gal

6. ANNUAL CONSUMPTION AND COST DATA

Fuel Type	Unit Cost	Annual Cost	Cost/MBtu
Electric			
34,000,000 KwH	$0.02.9/Kwh (1)	$1,000,000	$8.62
#5 Fuel Oil			
885,000 Gal.	0.66381	$ 695,600	$5.38
Propane	$0.449/Gal (3)	---	$5.00
TOTAL ANNUAL ENERGY COST		$1,695,600	

(1) at 3413 Btu/KwH
(2) at 148,000 Btu/Gal
(3) at 90,000 Btu/Gal

7. ENERGY CONSUMPTION CHARACTERISTICS

Electric

Based on historical experience, the mine uses electric power at a very steady rate. At mill start-up, the demand increases from a normal low 600-700 Kw demand up to an approximate 6,000 Kw demand. The demand meter then holds steady until the mill is shut down for the weekend.

The minimum demand of 600-700 Kw is power used for water pumping, lighting and miscellaneous mill equipment that remains in operation 24 hours per day.

Oil

Oil is used for three basic purposes:

1. Mill steam for maintenance and some processing requirements;

2. Winter space heating. The mill steam is provided in the summer by operating one of the three 150 Hp boilers (5,100 #/hr each) to provide the average 600 #/hr of steam. In the winter, at least two boilers are kept on line to meet the 8,600 #/hr. average winter steam demand; and

3. To generate hot gases to evaporate moisture from the vermiculite prior to storage and shipping. This is a very steady use rate when in operation for the five day operating schedule.

In summary, the energy consumption characteristics are very typical of a facility processing a very homogenious material stream.

LIST OF REFERENCES

- Utility electric billing information for a 12-month period.
- Fuel oil billing information for a 12-month period.
- Interview with Mr. Mike Ray, Plant Engineer, W.R. Grace & Co., Libby, Montana.
- Consulting Engineer: David G. Van Hersett, P.E., Resource Development Associates, Spokane, Washington.

TASK 105: BIOENERGY CONVERSION FACILITIES CONCEPTUAL DESIGN

1. INTRODUCTION

The facilities for the conversion of bioenergy (wood waste and forest residue) into thermal energy to dry vermiculite at the W.R. Grace mine in Libby, Montana can be best described as three subsystems. The burner and hot gas handling system combusts the wood, mixes the exhaust gases from the burner with ambient air to reduce the temperature prior to particulate removal and introduction into the drier. A second subsystem is provided to handle the sized fuel and temporarily store the material at the mine. Thirdly, a system to receive unsized fuel, segregated oversize material for hogging and provide long-term storage as needed at a location away from the mine.

The following sections describe these three systems:

2. GENERAL DESCRIPTION

a. Burner and gas handling system is shown schematically on Figure 1. The primary piece of equipment is the burner itself. A fluidized bed combustor was chosen because of the ability to accept various types and qualities of fuel and its suitability for hot gas collection for a drier. The combustor has a bed or thick layer of non-combustible material in the bottom of the furnace section that becomes suspended when air is blown in under the bed. The bed material behaves much like a boiling pot of water, hence the term "fluidized". Fuel is introduced above the bed or in the bed, depending on manufacturer and type of fuel. The fuel is agitated and mixed in the bed material allowing it to combine with combustion air. A fan is necessary to blow the air in under the bed to fluidize the material and provide combustion air.

The exhaust gases are approximately 1600 degrees F when they leave the combustor and must be mixed with cooler air before entering the particulate removal equipment. A blending air fan with an inlet control damper provides this air and mixes the cool air with the exhaust gases in a blending box. Ash particles are removed from the gases in a multiple cyclone mechanical separator to avoid contamination of the vermiculite. The cleaned gases will be approximately 850 degrees F when they enter the drier, which is consistent with temperatures now being attained with the burning of oil.

b. The fuel handling and storage system at the mine is shown schematically on Figure 2. The intent of the fuel handling design is to allow the greatest flexibility so the wood fuel or coal can be handled with minimal impact to the operation. Dump trucks will be used to transport fuel up to the mine and will dump their loads into a concrete hopper. The bottom of the hopper is provided with drag chain conveyors that unload the hopper, pass the fuel under an electric magnet to remove steel and iron, and drop the fuel on to a flexible wall conveyor. The flexible wall conveyor transports the fuel to a storage silo sized to handle wood fuel for three days of operation.

A removal in-line delumper is used to break up chunks of frozen coal when required, but can be pulled back out of the chute when wood fuel is being used, or the coal is not frozen, or for maintenance.

The storage bin is sized to give three days of continuous operation of the combuster using wood as a fuel since wood has the lower heating value per pound and is the least dense. A sweep auger is used to prevent bridging of the wood fuel in the bin and provide an even flow to the screw conveyor that feeds the pneumatic feed line to the combuster. The auger can be removed or left in place when coal is used, since coal flows quite readily in a bin with bottom walls sloped 60 degrees or greater.

c. The fuel handling and storage system away from the mine is shown schematically on Figure 3. Forest residue and wood waste will be received at the yard in large 20 unit vans. A single unit truck scale and dumper is used to weigh the incoming fuel and empty the truck into a hopper. The hopper is unloaded by a drag chain conveyor onto a belt conveyor that elevates the fuel to a disc screen. An electric magnet upstream of the screen removes any potentiallly damaging tramp iron. Tramp iron is miscellaneous steel scrap that gets into the fuel. The screen allows pieces 3 inches and smaller to pass through onto a belt conveyor for stackout on the storage pile. Oversize pieces are dropped into a hammer hog for size reduction before placement on the storage pile.

3. HEAT BALANCE

The heat or thermal energy required by the vermiculite drier is approximately 24.8 million Btu/hr. Wood fuel with an as-fired heating value of 4,000 Btu/lb. will be required at a rate of 6,200 lbs/hr. The exhaust temperature will be about 1,600 degrees if 117% excess air is used; different excess air volumes will alter the exhaust temperature. (Excess air is the amount of air supplied to the combustor over the amount required to ideally burn the fuel). Blending air at 70 degrees is required at a rate of 55,982 lbs/hr. to reduce the exhaust flow to 850 degrees. The flow rates, temperatures and pressures for strategic locations in the system are shown on Figure 1.

4. PROCESS DIAGRAM

The process diagrams for the combustor and gas handling, the fuel handling and storage at the mine, and the fuel handling away from the mine are shown on Figures 1, 2 and 3, respectively.

5. SITE LAYOUT

The conceptual arrangement of the primary pieces of equipment for the fuel handling and combustor at the mine are shown on Figure 4.

M.E. LAB
Montana Environmental Laboratory
376 W. Washington — P.O. Box 1876 Kalispell, Montana 59901 Phone: 755-2131

NEOMA (PENE) SOL

Date Received: 9-2-83
Date Reported: 9-19-83
MEL # : 472 thru 480

Reported To: W.R.Grace & Co. - ATTN: R. Geiger
Sample Source: W.R.Grace & Co.
Sample Date: 9-1-83

SPECIAL WATER ANALYSIS:

Parameter	Kcci # 6	Pumas Mill # 7	S.P. # 8	LOADING # 9	Limits
pH	8.0	7.1	7.3	7.4	---
Total Alkalinity as $CaCO_3$	93	342	254	207	---
Phenolphthalein Alkalinity	0	0	0	0	---
Calcium	8.0	20.0	33.7	44.9	---
Magnesium	27.6	73.9	45.6	30.7	---
Total Hardness as $CaCO_3$	133	353	271	238	0 - 4... Soft 5 - 12.. Mod. over 12. Hard
as gpg	7.8	20.6	15.8	13.9	
Total Iron	0.04	<0.01	0.02	0.46*	0.3
Sulfate	15.5	11.0	13.9	18.0	250
Nitrate as N	0.03	0.17	0.20	3.7	10
Total Dissolved Solids	122	365	300	266	500
Potassium	<2	[illegible]	4.7	1.2	---
Sodium	2.3	11.5	13.3	9.2	---
Arsenic	<0.005	<0.005	<0.005	<0.005	0.05
Barium	0.1	0.5	0.3	0.2	1.0
Cadmium	<0.001	<0.001	0.002	<0.001	0.010
Chromium	<0.02	<0.02	<0.02	<0.02	0.05
Chloride	2	8	3	6	250
Fluoride	0.22	1.44	1.09	0.22	2.4
Lead	<0.01	<0.01	0.02	0.02	0.05
Manganese	<0.02	0.02	<0.02	<0.02	0.05
Mercury	<0.001	<0.001	<0.001	<0.001	0.002
Selenium	<0.005	<0.005	<0.005	<0.005	0.01
Silver	<0.005	<0.005	<0.005	<0.005	0.05
Zinc	<0.01	1.59	2.36	1.52	---

NOTE: Water is suitable for drinking (except for problem (*) noted below) R5
(---) no established limits

* Total Iron #9 is over the limit of 0.3........

M.E. LAB

Montana Environmental Laboratory

376 W. Washington - P.O. Box 1876 Kalispell, Montana 59901 Phone: 755-2131

NEOMA (RENE) SOL

March 25, 1983

W.R. Grace & Co.
P.O. Box 609
Libby, Mt. 59923

Sample Date: 3-17-83

SPECIAL WATER ANALYSIS:

	RAINY ABOVE DIV. #1	TOE DRAIN #2	CARNEY #3	LOWER POND #4	RAINEY KOOT. #5	KOOT. R. #6
Total Suspended Solids (mg/l)................	1	1	120	6	26	12
Total Dissolved Solids (mg/l)................	234	431	327	358	341	238
Turbidity (NTU)................	.3	.5	80	2.4	10	5.8
Sulfate (mg/SO_4/l)............	5	12	21	13	15	16
Specific Conductance (micromhos/cm)........	350	690	400	565	520	370
pH....................	8.1	7.7	8.4	8.4	8.5	8.1
Total Phosphorus (mgP/l)..............	<0.01	0.43	0.47	0.31	0.34	0.16
Nitrate (NO_3-Nmg/l)...........	<0.01	<0.01	0.32	<0.01	<0.01	<0.01
Kjeldahl Nitrogen (mg/l)................	<0.3	<0.3	0.5	<0.3	<0.3	0.3
Ammonia (NH_3-Nmg/l)...........	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Fluoride (mg/l)................	0.10	4.7	<0.01	4.5	1.63	1.56

6. FUEL SPECIFICATION

WOOD RESIDUE FUEL

Heating Value

Range - 4,000 to 5,000 Btu/lb
Design - 4,500 Btu/lb (1)

(1) at 45% moisture

Fuel Size

Wood Residue (chipped)

		%
Max Size	- 3 inch	10%
Min Size	- 1/8 inch	80%
Average Size	- 1 inch	10%

Logging Residue (chipped)

Wood Type

Bark	20%
White Wood	75%
Needles/Cones	5%
	100%

Density

20 pounds per cubic foot

Specie Distribution

Lodgepole	50%
Cedar	10%
White Pine	10%
Ponderosa	10%
Hemlock	10%
Fir	10%
	100%

7. SOIL DATA

Based on the foundation design for the existing processing facilities, spread footings would be used. For conceptual design purposes, a 3,500 pounds per square foot soil bearing pressure will be used.

8. WEATHER DATA

Source: Climatological Data Annual Summary, Montana 1982, Volume 85, Number 13, National Oceanic and Atmospheric Administration, Asheville, North Carolina 28801.

Annual Precipitation: 20 inches

Temperature Extremes and Freeze Data °F:

Highest 97°
Lowest -16°

Cooling Degree Days - Base 65°F - 212 Annual
Average Temperature - Annual 45°F
Winter 27°F
Summer 64°F

9. LICENSING AND PERMITTING INFORMATION

- The particulate emissions must not exceed 25 tons per year.
- Ash disposal to be in mine tailings area.
- All waste water must be disposed in the existing mine waste water system.
- Plant water to be supplied from existing boiler water supply facilities.

10. PLANT OPERATING CRITERIA

The combustor operation will follow the drier operating schedule, which will be 5 days a week, 3 shifts per day, 250 days per year with 1 week shutdown for maintenance. The combustor must operate reliably when required, but the oil firing capability of the drier will remain in place and will provide emergency backup.

The storage bin at the mine allows for 3 days storage of wood so that fuel deliveries to the mine may be interrupted for this period without effecting the combustor operation.

11. PLANT OPERATING STAFF

The fluidized bed combustor will have automatic controls for fuel feed and combustion so that only periodic checks would be required. The fuel unloading and storage at the mine would require about one hour per day of operator surveillance. Since the demands for operator time are relatively small, the extra work load could be absorbed by the current staff at the mine with the proper training.

12. PLANT MAINTENANCE

With the exception of the controls, the fuel handling and storage and combustor systems have relatively conventional components that lend themselves to standard preventative maintenance practices with which the current mine staff is familiar.

13. MANUFACTURERS BROCHURE

The following brochures are included:

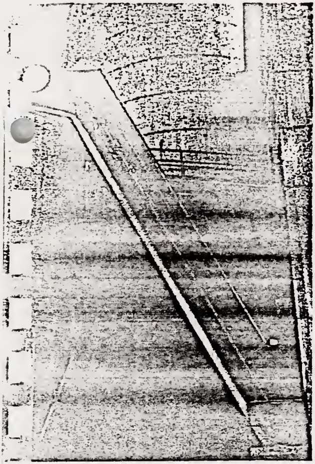
- Flexowall Conveyor
- Lamb Hammerhog
- Wellons Fuel Storage Silo
- Jacobson Crusher-Lumpbreaker

14. PLANNING COST ESTIMATES

Budgetary cost estimates for installed equipment are shown in Table 1 for the combustor and gas handling, Table 2 for the fuel handling and storage at the mine, and Table 3 for the fuel handling and storage away from the mine.

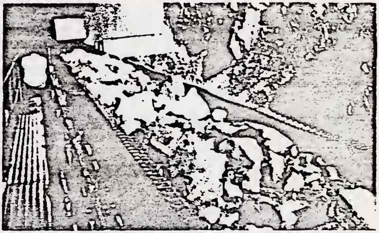
15. DESIGN, PROCUREMENT AND CONSTRUCTION SCHEDULE

A preliminary design, procurement and construction schedule is shown in Figure 5.

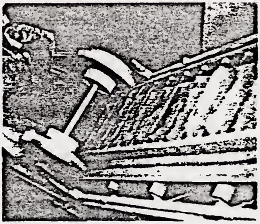


Flexowall®

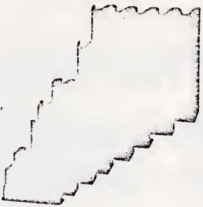
versatility of applications throughout the world . . .



for the conveying of bulk solids, including corrosive and abrasive materials.



SIDEWALL HEIGHTS



RUBBER CLEAT TYPES

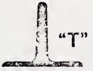


Fig. 1

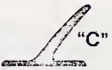


Fig. 2

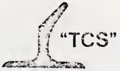
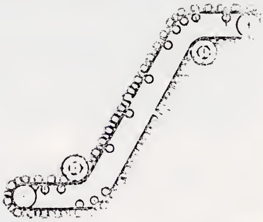


Fig. 3.

Flexowall conveyor belting systems are manufactured using sidewalls shown at left with either type T, C or TCS cleats depending on the angle of incline. The genetic design of the sidewall profile provides a more efficient discharge of material and less stress on the corrugations at head and tail pulleys. Application information should be submitted to the Flexowall engineering department for recommendation. (See figure 6.)

A comparison to conventional conveyors

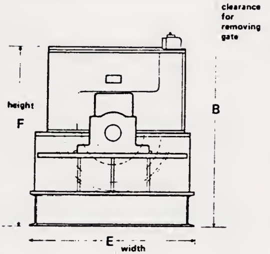


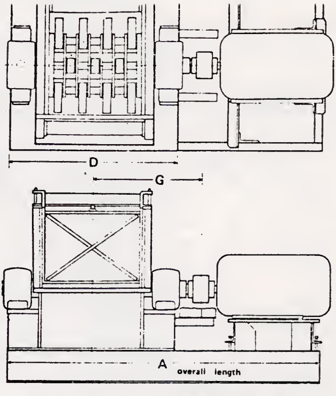
Ground Space Saved

Flexowall Features

- Patented cross-rigid base belt construction for trouble-free deflection and return
- All Flexowall belting is quality control checked during production
- Computerized engineering design provides immediate service on all inquiries
- Ample stocks of materials . . . means rapid delivery to meet project requirements
- A flow capacity from 1 to 10,000 tons

There's a Lamb Hammer Hog to meet your requirements





SIZE	A	B	C	D	E	F	G	NOMINAL INFEED OPENING	DISCHARGE OPENING
H423	91" 2310mm	70" 1780mm	31" 785mm	45" 1145mm	48" 1220mm	48" 1170mm	30¾" 780mm	16" x 23" 455mm x 585mm	43" x 25½" 1090mm x 650mm
H433	108" 2745mm	70" 1780mm	41½" 1055mm	55½" 1395mm	48" 1220mm	46" 1170mm	36" 915mm	18" x 33½" 455mm x 850mm	43 x 36" 1090mm x 915mm
H444	130" 3300mm	72" 1830mm	52" 1320mm	66" 1675mm	48" 1220mm	48" 1220mm	41¼" 1050mm	16" x 44" 455mm x 1120mm	43" x 47½ 1090mm x 1205mm
H627	112" 2845mm	103" 2615mm	37" 940mm	56" 1420mm	64" 1625mm	67" 1700mm	37⅜ 950mm	26 x 27" 660mm x 685mm	58" x 31 1475mm x 785mm
H636	121" 3075mm	103 2615mm	46½" 1180mm	65½" 1665mm	64" 1625mm	67" 1700mm	42⅛ 1070mm	26" x 36½" 660mm x 925mm	58' x 40½ 1475mm x 1030mm
H646	134 3405mm	103 2615mm	56" 1420mm	75" 1905mm	64" 1625mm	67" 1700mm	46⅞ 1190mm	26" x 46" 660mm x 1170mm	58" x 50" 1475mm x 1270mm
H656	146 3710mm	103 2615mm	65½" 1665mm	64½" 2145mm	64" 1625mm	67" 1700mm	51⅝" 1310mm	26" x 55½" 660mm x 1410mm	58" x 59½ 1475mm x 1510mm
H738	138 3505mm	109 2770mm	49 1245mm	74" 1880mm	71¾" 1820mm	76 1930mm	35⅛ 890mm	30" x 38" 760mm x 965mm	66 x 43" 1675mm x 1030mm
H748	149 3785mm	109" 2770mm	59 1500mm	64" 2135mm	71¾" 1820mm	76" 1930mm	49⅞ 1265mm	30" x 48" 760mm x 1220mm	66 x 53" 1675mm x 1345mm
H758	159 4040mm	109 2770mm	69" 1755mm	94" 2390mm	71¾ 1820mm	76" 1930mm	54⅝ 1385mm	30 x 56" 760mm x 1475mm	66" x 63" 1675mm x 1600mm
H768	169 4295mm	109 2770mm	79 2005mm	104" 2640mm	71¾" 1820mm	76" 1930mm	59⅝" 1510mm	30" x 68" 760mm x 1725mm	66" x 73" 1675mm x 1855mm
H848	173½" 4405mm	127⅞" 3250mm	60½" 1535mm	86" 2165mm	64" 2135mm	68⅞" 2255mm	56¾ 1440mm	34" x 48" 865mm x 1220mm	76" x 52½" 1930mm x 1335mm
H860	186 4725mm	127⅞ 3250mm	73" 1655mm	98½" 2500mm	64" 2135mm	88⅞" 2255mm	63" 1600mm	34 x 60½" 865mm x 1535mm	76" x 65" 1930mm x 1650mm
H872	198½" 5040mm	127⅞" 3250mm	65½" 2170mm	111" 2820mm	64" 2135mm	68⅞" 2255mm	69¼" 1760mm	34 x 73 865mm x 1855mm	76 x 77½ 1930mm x 1970mm
H950	TO SUIT MOTOR	139 3530mm	63" 1600mm	92" 2335mm	92" 2335mm	97" 2465mm	57½ 1460mm	38" x 49½" 865mm x 1255mm	84 x 54" 2135mm x 1370mm
H963	TO SUIT MOTOR	139" 3530mm	76" 1930mm	105" 2665mm	92" 2335mm	97" 2465mm	64 1625mm	38 x 62½ 865mm x 1590mm	64 x 67 2135mm x 1700mm
H976	TO SUIT MOTOR	139" 3530mm	69" 2260mm	116" 2995mm	92" 2335mm	97" 2465mm	70½ 1790mm	38" x 75½ 865mm x 1920mm	84" x 80" 2135mm x 2030mm

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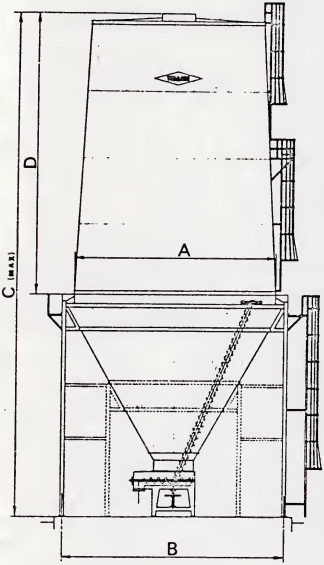


STORAGE CAPACITY (UNITS)

BIN MODEL	USEABLE	LEVEL FULL	DIM. "D" (INCLUDES BASE RING & ROOF)
A — 13 — 40	29	32	41′ — 2″
— 30	23	26	31′ — 2″
— 20	16	19	21′ — 2″
— 10	10	13	11′ — 2″
A — 17 — 40	48	53	41′ — 4″
— 30	38	43	31′ — 4″
— 20	27	33	21′ — 4″
— 10	16	22	11′ — 4″
A — 19 — 40	60	67	41′ — 6″
— 30	47	54	31′ — 6″
— 20	33	41	21′ — 6″
— 10	19	28	11′ — 6″
A — 21 — 40	72	82	41′ — 6″
— 30	57	67	31′ — 6″
— 20	40	51	21′ — 6″
— 10	23	35	11′ — 6″
A — 24 — 40	100	116	41′ — 8″
— 30	78	96	31′ — 8″
— 20	56	74	21′ — 8″
— 10	32	51	11′ — 8″
A — 30 — 40	152	182	41′ — 8″
— 30	118	150	31′ — 8″
— 20	83	117	21′ — 8″
— 10	46	83	11′ — 8″

MODEL	DIMENSIONS		
	"A"(BASE DIA.)	"B"	"C" (MAX.)
A — 13	13′ — 4″	16′ — 7″	59′ — 0″
A — 17	17′ — 2″	20′ — 5″	63′ — 3″
A — 19	19′ — 1″	22′ — 4″	65′ — 1″
A — 21	21′ — 0″	24′ — 3″	66′ — 9″
A — 24	24′ — 10″	28′ — 1″	70′ — 1″
A — 30	30′ — 7″	33′ — 10″	75′ — 2″

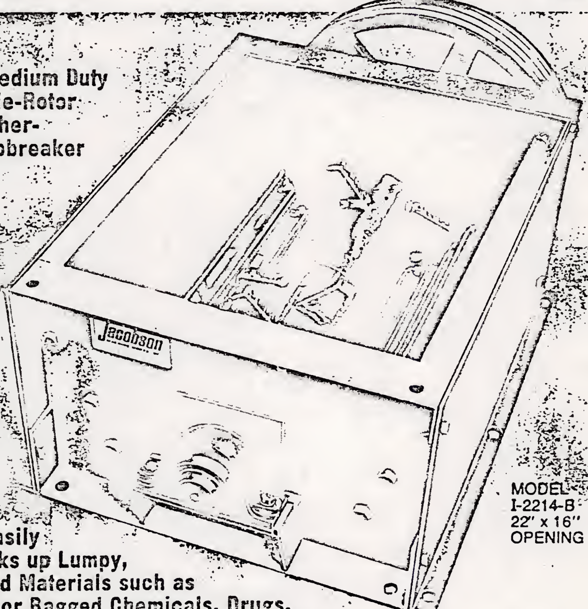
TOTAL H. P.	
STANDARD	SEVERE DUTY
7	8
8	8
8	8
8	10½
8	10½
8	10½

(1) Standard "D" silo height dimensions are from 10′ to 40′ in 10′ increments as shown on specification listing.
(2) Useable storage capacity is based on 45° angle of repose
(3) Normal discharge capacity - 6½ units per hour Higher capacities available.
(4) One unit is equal to 200 cubic feet or 5 664 cubic meters
(5) Silo has a negative slope

"FULL NELSON"™

Crushers-Lumpbreakers

☐ Medium Duty Single-Rotor Crusher-Lumpbreaker



MODEL
I-2214-B
22" x 16"
OPENING

☐ Easily Breaks up Lumpy, Caked Materials such as Bulk or Bagged Chemicals, Drugs, Fertilizers, Friable Plastics, Expellor Cake or Filter Cake, Dried or Frozen Foods, Hard Candies

TABLE 1

BUDGETARY COSTS FOR COMBUSTOR AND GAS HANDLING EQUIPMENT

Fluidized Bed Combustor with fluidizing fan and motor and operator control panel	$320,000
Blend Chamber	24,000
Refactory Lined Elbow	15,000
Preinsulated Ducting	48,000
Multiple Cyclone Separator with transitions	110,000
Sub-total	$517,000
Installation	129,500
TOTAL	$646,250

Delivery Time. 5-6 months

TABLE 2

BUDGETARY COSTS FOR FUEL HANDLING AND STORAGE AT MINE

Storage Bin with weather enclosure, sweep auger and botton unloading augers-100 units (48 unit-$69,280)	$104,520
Truck Dump Hopper with live bottom drag chain, "grizzly" grating, shear gate	35,500
Magnet	7,000
Crusher (delumper)	6,000
Flexible Wall Belt Conveyor	21,700
Pneumatic Feel with blower and piping	3,000
Sub-total	$188,720
Installation	47,200
Misc, Civil and Electrical	40,000
TOTAL	$264,920
	(11,000)
	$264,920

Delivery Time: 3-4 months

TABLE 3

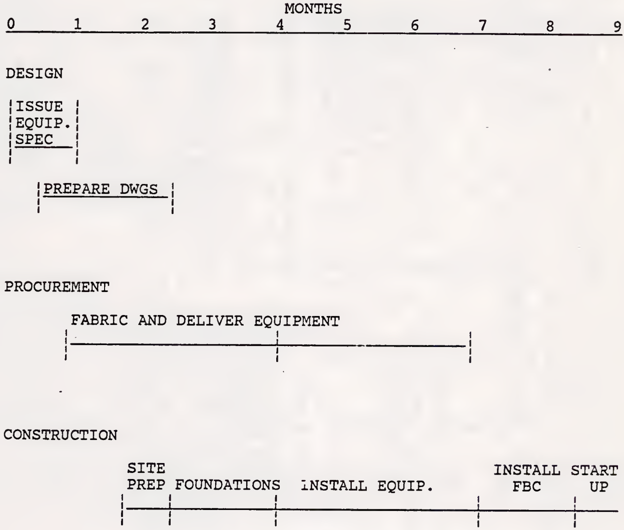
BUDGETARY COSTS FOR FUEL HANDLING AND STORAGE AWAY FROM MINE

Truck Dumper with scale	$105,750
Hopper with live bottom drag chain	112,500
Magnet	15,000
Belt Conveyor - 24 inches by 90 feel long	45,000
Disc Screen with two chutes	30,000
Hammer Hog with 75 hp motor	30,000
Belt Conveyor - 24 inches by 200 feet	90,000
Motor Starters and Controls	7,600
Sub-total	$435,850
Installation	108,950
TOTAL	$544,800

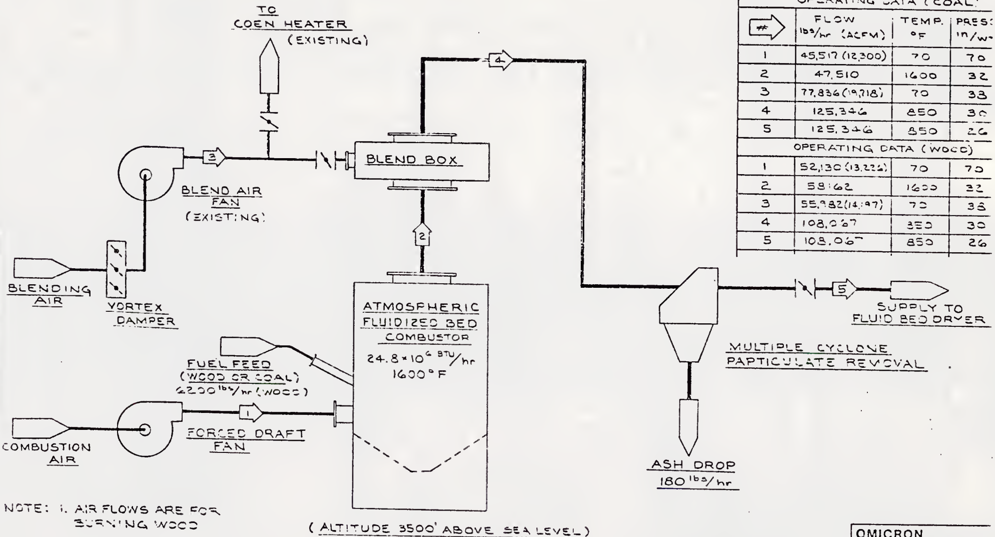
Delivery Time: 4 months

Figure 5

PLANNING SCHEDULE - LIBBY, MT



Note: The fluidized bed combustor is on the critical path and is shown on the time line for critical path and is shown on the time line for procurement. All other equipment will be delivered and installed prior to completion of the FBC.



OPERATING DATA (COAL)			
#	FLOW lbs/hr (ACFM)	TEMP. °F	PRES in/w
1	45,517 (12,300)	70	70
2	47,510	1600	32
3	77,836 (19,718)	70	33
4	125,346	850	30
5	125,346	850	26
OPERATING DATA (WOOD)			
1	52,130 (13,226)	70	70
2	58,162	1600	32
3	55,982 (14,197)	70	33
4	108,067	850	30
5	108,067	850	26

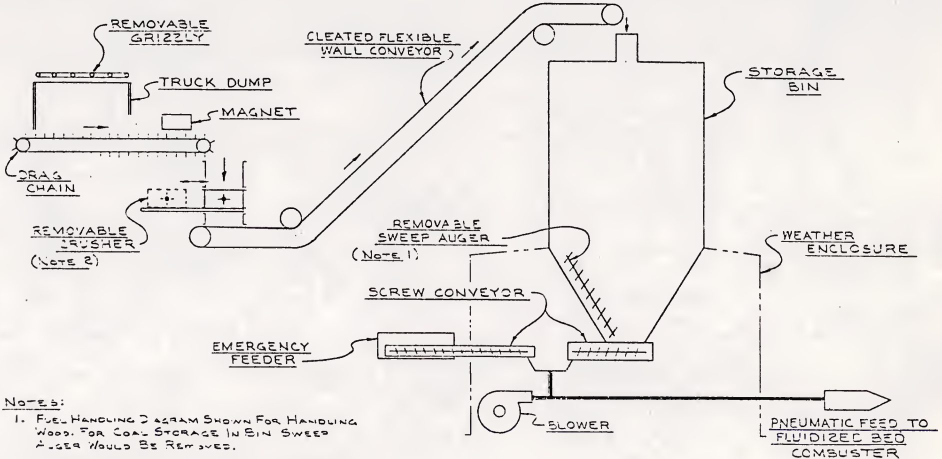
NOTE: 1. AIR FLOWS ARE FOR BURNING WOOD

(ALTITUDE 3500' ABOVE SEA LEVEL)

SOLID FUEL COMBUSTION DIAGRAM

OMICRON
ENGINEERS AND CONSULTANTS, IN

FIGURE 1


REMOVABLE GRIZZLY
TRUCK DUMP
MAGNET
DRAG CHAIN
REMOVABLE CRUSHER (Note 2)
CLEATED FLEXIBLE WALL CONVEYOR
STORAGE BIN
REMOVABLE SWEEP AUGER (Note 1)
WEATHER ENCLOSURE
SCREW CONVEYOR
EMERGENCY FEEDER
BLOWER
PNEUMATIC FEED TO FLUIDIZED BED COMBUSTER

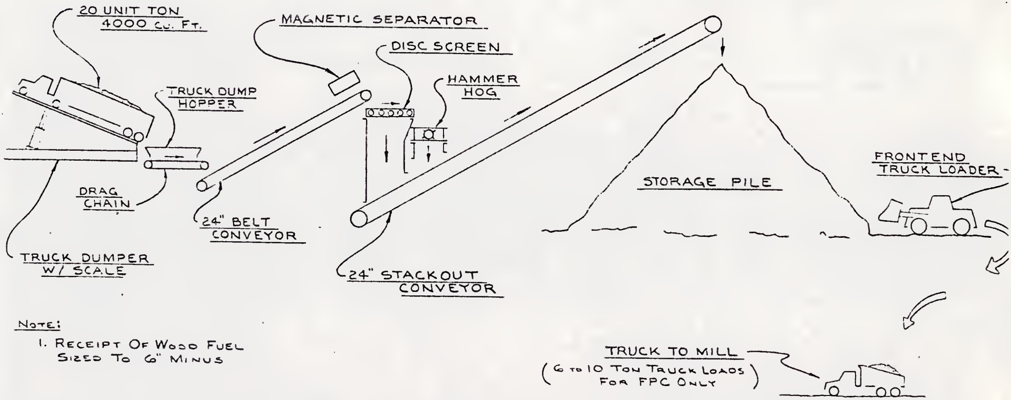
Notes:

1. Fuel Handling Diagram Shown For Handling Wood. For Coal Storage In Bin Sweep Auger Would Be Removed.
2. Crusher Can Be Pulled Out Of Line For Maintenance Or During Non-Freezing Months.

FUEL HANDLING DIAGRAM

OMICRON
ENGINEERS AND CONSULTANTS, IN

FIGURE 2



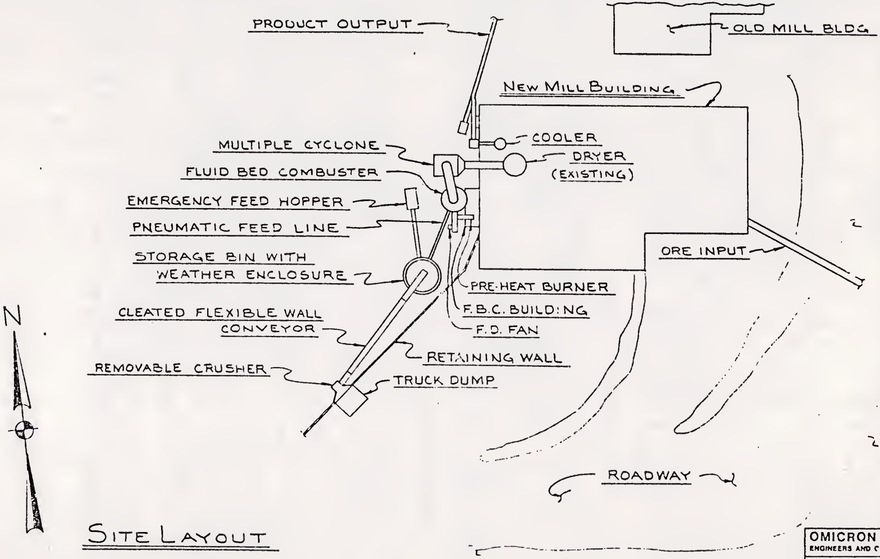
NOTE:

1. RECEIPT OF WOOD FUEL SIZED TO 6" MINUS

FUEL HANDLING AND STORAGE YARD

OMICRON
ENGINEERS AND CONSULTANTS, IN

FIGURE 3



SITE LAYOUT

OMICRON
ENGINEERS AND CONSULTANTS, IN

FIGURE 4

TASK 106: BIOENERGY SUPPLY SYSTEM PRELIMINARY ECONOMICS

1. INTRODUCTION

The first phase of the Libby Bioenergy Project is to demonstrate to W.R. Grace & Co. that forest residue is a firm and reliable alternative energy option for their mining operation. Libby is located in the center of an established timber production region. The waste products not used by the forest products industry can be manufactured into a traditional fuel product, which can be fed into conventional wood fuel burners to produce energy for the mining operations. This section integrates the previously described components into a functional unit and prepares a base case economic performance analysis. This base case analysis will be used to formulate the plan for proceeding to the next phase.

2. PURPOSE AND TASK DESCRIPTION

The purpose of this task is to prepare a preliminary economic performance profile for a bioenergy supply system. Information obtained in the preceding tasks will be used; cost for fuel F.O.B. to the W.R. Grace mine will be estimated. The result will be cost and performance analysis for the fuel supply system broken down into: forest residue (stumpage), recovery, preparation, transportation, fuel handling and storage, and energy conversion.

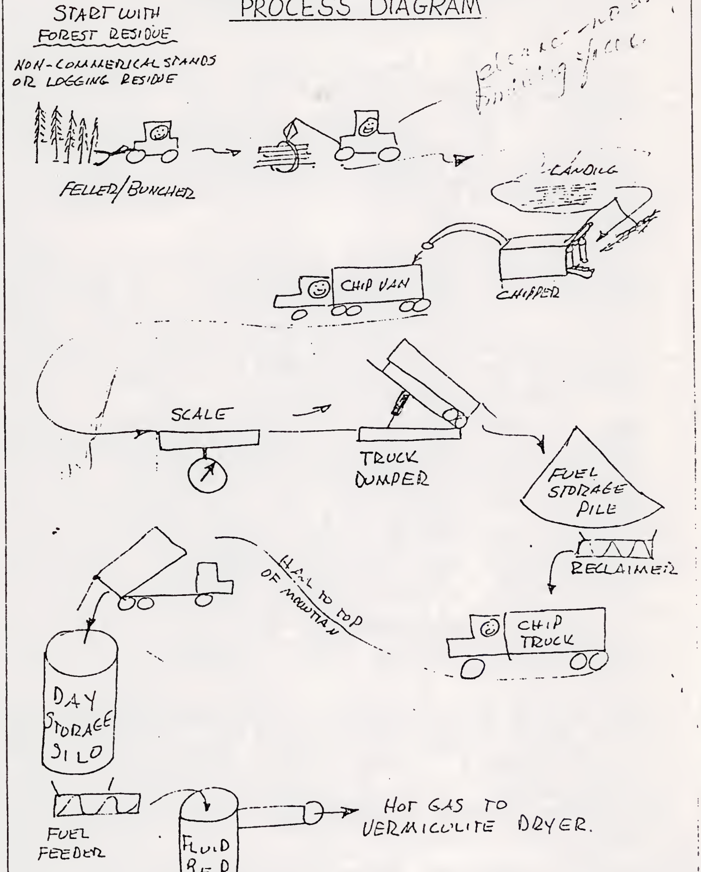
3. BIOENERGY SUPPLY SYSTEM DESCRIPTION

The cost and system performance data prepared in this task is for a system to harvest stagnated lodgepole pine stands having an average stem diameter of 3 to 4 inches. These stands are located within a 50-mile haul distance of the W.R. Grace mine.

Two forest residue recovery systems were configured for the initial phase investigations. These two alternatives will be known as: (1) in-woods chipping, and (2) chip-at-plant. The in-woods chipping system is shown on the following process diagram. The system consists of feller-bunchers cutting trees and accumulating them in piles. A grapple skidder then grabs the pile and drags it to a landing. At the landing, the trees, limbs and all are fed to a portable chipper and blown into a waiting chip van. The fuel chips are then hauled to a fuel storage pile at the W.R. Grace mine.

The chip-at-plant system locates the chipper at the fuel storage pile rather than in the woods. Whole trees are loaded onto logging trucks with special side rails and hauled to a central location for chipping.

LIBBY BIOENERGY PROJECT
PROCESS DIAGRAM



DUH 10/83

The burner and gas handling system is shown schematically on Figure 1 (Task 105). The primary piece of equipment is the burner itself. A fluidized bed combustor was chosen because of its ability to accept various types and qualities of fuel and its suitability for hot gas collection for a drier.

The combustor has a bed or thick layer of non-combustible material in the bottom of a furnace section that becomes suspended when air is blown in under the bed. The bed material behaves much like a boiling pot of water, hence the term "fluidized". Fuel is introduced above the bed or in the bed, depending on the manufacturer and type of fuel. The fuel is agitated and mixed in the bed material allowing it to combine with combustion air. A fan is necessary to blow the air in under the bed to fluidize the material and provide combustion air.

The exhaust gases are approximately 1600 degrees F when they leave the combustor and must be mixed with cooler air before entering the particulate removal equipment. A blending air fan with an inlet control damper provides this air and mixes the cool air with the exhaust gases in a blending box. Ash particles are removed from the gases in a multiple cyclone mechanical separator to avoid contamination of the vermiculite. The cleaned gases will be approximately 850 degrees F when they enter the drier, which is consistent with the temperatures now being attained with the burning of oil.

The fuel handling and storage system at the mine is shown schematically on Figure 2 (Task 105). The intent of the fuel handling design is to allow the greatest flexibility so that wood fuel or coal can be handled with minimal impact to the operation. Dump trucks will be used to transport fuel up to the mine and will dump their loads into a concrete hopper. The bottom of the hopper is provided with drag chain conveyors that unload the hopper and pass the fuel under an electric magnet to remove steel and iron. The fuel is dropped onto a flexible wall conveyor that transports the fuel to a storage silo sized to handle wood fuel for three days of operation.

A removable in-line delumper is used to break up chunks of frozen coal when required, but can be pulled back out of the chute when wood fuel is being used, or the coal is not frozen, or for maintenance.

The storage bin is sized to give three days of continuous operation of the combustor using wood as fuel because wood has the lower heating value per pound and is the least dense. A sweep auger is used to prevent bridging of the wood fuel in the bin and provide an even flow to the screw conveyor that feeds the pneumatic feed line to the combustor. The auger can be removed or left in place when coal is used, since coal flows quite readily in a bin with bottom walls sloped 60 degrees or greater.

The fuel handling and storage system away from the mine is shown schematically on Figure 3. Forest residue and wood waste will be received at the yard in large 20 unit vans. A single unit truck scale and dumper is used to weigh the incoming fuel and empty the truck into a hopper. The hopper is unloaded by a drag chain conveyor onto a belt conveyor that elevates the fuel to a disc screen. An electric magnet upstream of the screen removes any potentially damaging tramp iron. The screen allows pieces 3 inches and smaller to pass through onto a belt conveyor for stackout on the storage pile. Oversized pieces are dropped into a hammer hog for size reduction before placement on the storage pile.

4. BIOENERGY SYSTEM PERFORMANCE CHARACTERISTICS

Forest Residue Reserves (Stumpage Fee)

Annual forest residue (logging residue and stand conversion residue) produced in the Kootenai National Forest:

Logging Residue	1,594,000
Stand Conversion Residue	244,000
TOTAL ANNUAL RESIDUE	1,838,000

Lowest cost stand conversion residue (less than 40% slope and existing access roads) is 5,556 acres, or	111,320 tons
Unroaded stands at less than 40% slope are 7,132 acres, or	142,640 tons
Recoverable stagnated lodgepole stands	253,960 tons

Note: This does not include beatle kill areas, etc.

Stumpage fees would be in the form of a contract with the U.S. Forest Service to remove these stagnated lodgepole pine stands over a ten year period. The stumpage fee would be at zero or minimal cost to Rayson Brothers. These reserves will be used by Rayson as the ace in the hole to cover any fuel supply shortages that may occur from the normal logging residue recovery operation.

Logging Residue Reserves (Stumpage Fees)

Logging residue recovery will be the main fuel supply source because of its larger volume potential of 1,594,000 tons per year. Rayson Brothers will integrate logging residue recovery with their traditional timber logging operations. Historically, the Rayson Brothers have logged approximately 1 million board feet (5,000 tons) of timber per year.

The stumpage fees for logging residue are included in the base timber fees and thus, no cost to the logging residue operation. The logging cleanup fees will be used to support the logging residue operation.

Residue Recovery Operation

To establish a base line cost representing the most conservative method to supply a firm bioenergy fuel to W.R. Grace, the recovery of non-commercial stands such as stagnated lodgepole stands was selected. The cost performance of this bioenergy fuel supply system will be based on existing operations in the Pacific Northwest.

The following presents the operating cost estimates for the four scenarios developed for the forest residue recovery base case:

Case 1: Chipping-at-Plant: Optimum Equipment Performance
72,000 tons per year

Case 2: In-Woods-Chipping: Optimum Equipment Performance
72,000 tons per year

Case 3: Chipping-at-Plant: Dryer Fuel Production
12,000 tons per year

Case 4: In-Woods-Chipping: Dryer Fuel Production
12,000 tons per year

MONTHLY OPERATING COSTS

CHIPPING AT PLANT: OPTIMUM EQUIPMENT PERFORMANCE (72,000 tons per year)

Equipment-Production		
Labor - Direct (11/22) @ $13.00	$ 42,900	
Labor - PR Taxes (30%)	12,870	
Labor - Fringe (5%)	2,145	
Diesel	13,200	
Gas	150	
Repairs-Maintenance	14,654	
Parts-Supplies (5%)	7,327	
Insurance-Liab. & Casual.	9,800	
Licenses-Permits	300	
PU Expense (.25 mile)	2,284	
Stumpage	-0-	
Depreciation (3 years)	49,038	
		$154,671
General		
Office Rent	$ 400	
Bookkeeping	880	
Management	5,642	
Management-PR Txs (10%)	1,304	
Management - Fringe (5%)	326	
Legal-Accounting	400	
Insurance	35	
Travel & Entertainment	375	
		9,362
Other		
Equipment Lease Costs	$ 39,196	
Professional Services	2,400	
Fuel Hauling Contract	55,542	
		97,139
TOTALS		$261,172
Operating Profit (before tax)		52,234
GRAND TOTAL		$313,406

SUMMARY

Ton Cost	$25.39
Ton Sale	30.47 (1)

NET PROFIT $ 5.08 = $365,636

Note (1): Seven months per year operating schedule.

MONTHLY OPERATING COSTS

IN-WOODS CHIPPING: OPTIMUM EQUIPMENT PERFORMANCE

Equipment Production		
Labor - Direct (18/9) @ $13.00	$ 35,100	
Labor - PR Taxes (30%)	10,530	
Labor - Fringe (5%)	1,755	
Diesel	10,725	
Gas	150	
Repairs-Maintenance	11,042	
Parts-Supplies (5%)	5,521	
Insurance-Liab. & Casual.	9,000	
Licenses-Permits	250	
PU Expense (.25 mile)	2,287	
Stumpage	-0-	
Depreciation (3 years)	38,047	
		$124,407
General		
Office Rent	$ 400	
Bookkeeping	880	
Management	5,642	
Management-PR Txs (10%)	1,304	
Management - Fringe (5%)	326	
Legal-Accounting	400	
Insurance	35	
Travel & Entertainment	375	
		9,362
Other		
Equipment Lease Costs	$ 31,301	
Professional Services	2,400	
Fuel Hauling Contract	72,030	
		105,731
TOTALS		$239,500
Operating Profit (before tax)		47,900
GRAND TOTAL		$287,400

SUMMARY

Ton Cost	$23.28
Ton Sale	27.94 (1)

NET PROFIT $ 4.66 = $335,520

Note (1): Seven months per year operating schedule.

MONTHLY OPERATING COSTS

CHIPPING AT PLANT: DRYER FUEL PRODUCTION

Equipment Production		
Labor - Direct (3) @ $13.00	$ 6,864	
Labor - PR Taxes (30%)	2,059	
Labor - Fringe (5%)	343	
Diesel	1,936	
Gas	25	
Repairs-Maintenance (10%)	2,472	
Parts-Supplies (5%)	1,236	
Insurance-Liab. & Casual.	1,650	
Licenses-Permits	105	
PU Expense (.25 mile)	480	
Stumpage	27,428	
Land Lease (Yard) <on site>	1,000	
Depreciation (3 years)	8,240	
		$ 53,838
General		
Office Rent	$ 400	
Bookkeeping	500	
Management	5,642	
Management-PR Txs (10%)	1,228	
Management - Fringe (5%)	307	
Legal-Accounting	250	
Insurance	25	
Travel & Entertainment	200	
		8,552
Other		
Equipment Lease Costs	$ 8,752	
Professional Services	1,714	
No freight - On-site Facility	-0-	
		10,466
TOTALS		$ 72,856
Operating Profit (before tax)		14,571
GRAND TOTAL (1)		$ 87,427

SUMMARY

Ton Cost	$42.50
Ton Sale	51.00

NET PROFIT $ 8.50 = $102,008

Note (1): Seven months per year operating schedule.

MONTHLY OPERATING COSTS

IN-WOODS CHIPPING: DRYER FUEL PRODUCTION

Equipment Production		
Labor - Direct (4) @ $13.00	$ 9,152	
Labor - PR Taxes (30%)	2,745	
Labor - Fringe (5%)	458	
Diesel	2,178	
Gas	105	
Repairs-Maintenance	3,688	
Parts-Supplies (5%)	1,844	
Insurance-Liab. & Casual.	2,950	
Licenses-Permits	195	
PU Expense (.25 mile)	1,398	
Stumpage	-0-	
Depreciation (3 years)	12,652	
		$ 37,362
General		
Office Rent	$ 400	
Bookkeeping	500	
Management	5,642	
Management-PR Txs (20%)	1,228	
Management - Fringe (5%)	307	
Legal-Accounting	250	
Insurance	25	
Travel & Entertainment	200	
		8,552
Other		
Equipment Lease Costs	$ 12,937	
Professional Services	1,714	
Fuel Hauling Contract	12,000	
		26,651
TOTALS		$ 72,565
Operating Profit (before tax)		14,513
GRAND TOTAL (7 months per year)		$ 87,078

SUMMARY

Ton Cost	$42.33
Ton Sale	50.80

NET PROFIT $ 8.47 = $101,640

Fuel Handling Storage

The labor to operate the fuel handling/storage facilities is included in the respective scenerio for the base case. The facilities to provide for fuel receiving, storage, reclaim and loading into truck for transport to the mine are estimated at $544,800. The annual operating costs for this system are estimated as follows:

Annual capital recovery at 15% and a 15 year life are	$ 93,170/yr.
Annual maintenance supplies @ 1%	5,448/yr.
Annual power costs:	
150 hp connected x 250 days x 8 hr/day x 30% load factor = X.745 kw/hp = 67,050 KwK x $0.04/KwH =	2,682
Haul truck costs @ $0.13/ton mile x 5 mile haul x 12,000 tons =	7,800
Annual Fuel Storage/Handling Cost	$109,100

Energy Conversion

The energy conversion facility cost is estimated at:

Combustion and gas handling equipment	$646,250
Mine fuel handling and storage	264,920
TOTAL	$911,170

Annual operating costs are estimated as follows:

Annual capital recovery (15 years @ 15%)	$155,826/yr.
Incremental operating costs over existing system	none
Ash disposal cost - $2/ton @ 5% ash x 12,000 tons	1,200
TOTAL COST FOR ENERGY CONVERSION	$157,026

5. SYSTEM ECONOMIC PERFORMANCE CHARACTERISTICS

The bioenergy fuel supply system has as its energy source the renewable forest that surrounds the Libby area. This renewable resource is independent of all traditional world energy impacts to which the oil market is vulnerable.

The fuel supply strategy developed includes:

- Recovery of logging residues from traditional logging operations.
- An independent reserve of stagnated non-commercial stands to cover any shortages of logging residue due to potential upsets in the traditional lumber and chip market.
- Independent local contractor.
- A locally manufactured energy resource.
- Long-term cost escalation keyed to the forest products industry, which has a lower escalation rate than most traditional industries.
- Utilizes waste products of the forest products industry.

6. BIOENERGY SYSTEM COST PERFORMANCE BY SUBSYSTEM

Stumpage: Dryer Fuel: 12,000 tons per year

Residue Recovery Costs (in-woods chipping)

Capital Recovery	$ 12,937	
Hauling Cost	12,000	
Operating Cost	37,362	
General	8,552	
Contract	1,714	
Sub-total	$ 72,565	
Operating Profit	14,513	
RECOVERY COST		$ 87,078
Fuel Storage and Handling		109,100
Fuel Conversion		157,026
TOTAL ANNUAL BIOENERGY COST		$353,204
Annual Cost/Ton Fuel		$ 29.43/ton

7. BIOENERGY FUEL SUPPLY PERFORMANCE CHARACTERISTICS

Dryer Fuel Requirements

Annual Fuel Quantity 570,000 gallons oil
Annual Energy Rqmt. @ 148,000 Btu/gal #5 oil

$$= 8.44 \times 10^{10} \text{ Btu's}$$

Annual Wood Rqmts. @ 4,500 Btu's per pound (9.0 x 10^6 Btu/ton)

$$= \frac{8.44 \times 10^{10} \text{ Btu} \times .95 \text{ boiler efficiency}}{9.0 \times 10^{6} \text{ Btu/ton} \times 0.65 \text{ boiler efficiency}}$$

= 13,706 tons coal per year

Average Monthly Fuel Rqmt.

$$= \frac{13{,}706 \text{ tons}}{12 \text{ mos.}} = 1{,}143 \text{ tons}$$

Average Weekly Fuel Rqmt.

$$= \frac{13{,}706 \text{ tons}}{50 \text{ weeks}} = 274 \text{ tons}$$

Average Daily Fuel Rqmt.

$$= \frac{274 \text{ tons}}{5 \text{ days}} = 54.8 \text{ tons per day}$$

Steam Fuel Requirements

Annual Fuel Quantity 315,000 gallons
Annual Energy Rqmt. @ 148,000 Btu/gallon #5 oil

$$= 4.662 \times 10^{10} \text{ Btu's}$$

Annual Wood Requirements @ 4,500 Btu per pound (9.0×10^6 Btu/ton)

$$= \frac{4.662 \times 10^{10} \times 0.95 \text{ boiler efficiency}}{9.0 \times 10^6 \text{ Btu/ton} \times 0.65 \text{ boiler efficiency}}$$

= 7,571 tons coal per year

Average Monthly Fuel Requirement

$$= \frac{7{,}571 \text{ tons}}{5 \text{ months}} = 1{,}514 \text{ tons per month}$$

Average Weekly Fuel Requirement

$$= \frac{2{,}950 \text{ tons}}{5 \text{ months} \times 52 \text{ weeks}/12} = 349.4 \text{ tons per week}$$

Average Daily Fuel Requirement

$$= \frac{349.4 \text{ tons per week}}{5 \text{ days}} = 70 \text{ tons/day}$$

Electric Fuel Requirements

Annual Fuel Requirements 34,000,000 KwHr
Annual Fuel Quantity @ 14,000 Btu/KwHr
for coal fueled power plant

$$= \frac{34{,}000{,}000 \text{ KwHr} \times 14{,}000 \text{ Btu/KwHr}}{9{,}000{,}000 \text{ Btu/ton fuel}}$$

= 52,889 tons coal per year

Average Monthly Fuel Requirement

$$= \frac{52{,}889 \text{ tons}}{12} = 4{,}407 \text{ tons/month}$$

Average Weekly Fuel Requirement

$$= \frac{42{,}889 \text{ tons}}{50 \text{ weeks}} = 1{,}058 \text{ tons/week}$$

Average Daily Fuel Requirements

$$= \frac{1{,}058 \text{ tons}}{5} = 212 \text{ tons per day}$$

TASK 107: COAL SUPPLY SYSTEM

1. INTRODUCTION

Coal is a traditional energy source for industry. The nearest viable coal supplies to Libby, Montana are the Crows Nest Mine, Fernie, B.C. (120 miles), Buckskin Mine, Gillett, Wyoming, and Western Energy mine at Colstrip, Montana. All three coal mines have production capacities in excess of one million tons per year. Each coal source has a unique chemistry and must be carefully matched to the type of coal burning equipment to ensure compatibility.

2. PURPOSE AND TASK DESCRIPTION

The purpose of this task is to document the coal supply system, define the transportation system and secure a copy of a sample coal supply contract. The fuel supply reserves, quantities available, specifications and costs will be documented for the mine.

3. DESCRIPTION OF COAL SUPPLY SYSTEM

The coal from the Crows Nest Mine at Fernie, B.C. is substantially cheaper than the two other mines:

Location	Cost per Million Btu
Crows Nest, Fernie, B.C.	$ 1.98
Buckskin Mine, Wyoming	3.26
Western Energy, Montana	3.54

For this investigation, only the Fernie, B.C. coal will be evaluated because of its lower cost.

The Crows Nest mine at Fernie, B.C. is approximately 120 miles north of Libby, Montana. The mine produces metallurgical and thermal coal for markets around the world. The metallurgical coal is used in the manufacturing of steel and has a high value on the world market.

The lower quality (thermal) coal, is a by-product of the metallurgical coal operation and is availbale at a relatively low cost at the mine. The coal would be loaded into trucks and hauled 120 miles to Libby. The transportation cost is the primary element in the cost of thermal coal. Rail transportation is more costly than trucking because of the small quantities required by the mine and higher transportation rates of the railroad.

Tests were conducted in January and February 1982 to burn a coal sample to ensure that the coal is acceptable for boiler operation. The test report is in Appendix A.

The Canadian coal supply could be inaccessible in the event of actions by either the United States or Canadian governments.

5. FUEL TRANSPORTATION SYSTEM

Fuel for the process at Libby can be broken down into two broad categories, liquid and solid fuel.

Liquid fuels are easily sotred, but the price is prohibitive; they will be considered as a standby fuel. For the purpose of this study, liquid fuels have been ruled out as a primary fuel alternative.

Solid fuels can be shipped into Libby in one of two ways. The first way is by rail. This method would entail the construction of a $150,000 unloading facility. Additional maintenance costs and labor costs would be incurred with the rehandling of the solid fuel from the train to a truck for transportation to the mine site. Once at the mine site, a truck dump would have to be constructed just as if the solid fuel had been trucked from its origin. Therefore, it makes sense to circumvent the additional capital outlay and maintenance problems and truck the fuel the entire distance. This makes even more sense in light of the fact that there are several fuel sources, including waste wood fuel and coal within trucking distance at a cost savings over rail transportation. The price for a ton of coal to be brought from our closest source, Fernie, British Columbia by rail is $22.00 per ton. By truck, that same ton of coal would cost $14.75 to move by contract carrier. Using W.R. Grace trucks and personnel, the cost would be $16.35 per ton. See Appendix B for calculations. It is concluded that the solid fuels be trucked to the mine site and a truck dump constructed for contract haul or to haul the fuel with Grace trucks.

TRUCK DUMP

A truck dump was designed to handle coal and waste wood fuels. There were several truck dump models handling just coal or just hog fuel. The truck dump models designed to handle only coal would cause bridging problems with the hog fuel. The units designated for hog fuel would wear out in an extraordinarily short time if subjected to the abrasiveness of coal.

The design criteria for the truck dump included adaptability to any solid fuel. It had to be large enough to accept a 12 unit hog fuel trailer (1 unit equals 200 cu. ft.) and must be able to service both belly dump and end dump trailers. Also, some sort of dust suppression system had to be included should it be needed with the coal dumps.

The design arrived at included a concrete hopper 12' wide by 15' long by 15' deep. In order to alleviate the bridging problems with hog fuel, the system was designed to allow for a live bottom feeder arrangement. These screw conveyors will discharge onto a converging screw conveyor that will collect and discharge into a single chute to the bucket elevator, as shown in Figure 1. The hopper includes a portable cover to reduce equipment deterioration due to weathering. When hog fuel is not used as the primary fuel source, a false bottom would be installed to handle coal.

The chute from the truck dump to the bucket elevator will include two items: (1) a magnet to retrieve the majority of the tramp iron, which protects the crusher, and (2) a crusher to reduce the oversize material. The crusher is intended more as a delumper rather than as a particle size reducer. Coal delivered in the winter will have a tendency to lump and could cause some problems with the pneumatic feed line. As an added advantage, other larger sized coals could be used in the event of an emergency or as a less expensive source.

A bypass will be installed to allow those particles not requiring delumping to pass by the crusher without adding to its wear. It will also serve as a bypass when hog fuel or similar fuels are used.

The chute will feed a conveyor that will raise the material to a height that will allow gravity flow to carry the solid fuel into the silo by means of additional chute work.

FUEL STORAGE

A similar problem to the universality of the truck dump was encountered with the fuel storage system. Coal can flow out of any properly constructed tapered discharge silo. Hog fuel will bridge and cause feed problems to the burner when stored in the same silo design. On the other hand, an efficient system to store and retrieve hog fuel is normally a high maintenance item when subjected to abrasive materials such as coal.

A compromise was gained by using a silo storage system developed by Wellons, Inc. of Portland, Oregon. Their system involves a tapered discharge silo and an agitator screw that runs along the inside of the tapered bottom (see Appendix D). The system was designed primarily for the wood products industry, but is adaptable to any solid fuel.

When coal is used as the primary fuel, the agitator can be deleted. When hog fuel is used, the agitator will be required.

Note: The silo proposed is a Wellons unit. The silo is 17 feet in diameter and 40 feet high. This will give a useable storage capacity of 10,200 cubic feet. This equates to enough for 12 days of operation if coal is used and 3 days if hog fuel is used. The Wellons silos are of a bolt-together plate construction.

The Wellons Posi-flow Silo offers flexibility, economy and reliability for all solid fuels.

6. SAMPLE FUEL SUPPLY CONTRACT

The mine does not have a standard thermal coal contract. The contract envisioned is a simple letter contract for a short term, one to five years in duration. The fuel pricing structure is anticipated to be the most difficult part of the contract negotiation. Because the mining operation primary product is a high value metallurgical coal and the annual volume purchased is a small quantity, the basic fuel purchase contract will be simple in form and content.

The following is an outline of the major provisions proposed for a coal supply contract:

- Term
- Price
- Specification
- Quantity
- Shipping

7. COAL RESERVES AVAILABLE

The Crows Nest Mine is operated by Kaiser Resources Coal Division. They mine approximately 10 million tons of metallurgical coal annually. The reported coal reserves are in excess of 2 billion tons. This is a 200 year supply of coal and is more than adequate to ensure a fuel resource for W.R. Grace vermiculite mine.

8. COAL SPECIFICATIONS

	Typical
Moisture (Total)	15.0%

Proximate Analysis (Air Dry):

Inherent Moisture	1.5%
Ash	33.0%
Volative Matter	18.0%
Fixed Carbon	47.5%
Sulphur	0.3%

Hardgrove Grindability	105

Ash Analysis:

SiO_2	-	60.2%	CaO	-	2.7%
Al_2O_3	-	28.9%	MgO	-	0.9%
Fe_2O_3	-	3.9%	SO_3	-	1.2%
TiO_2	-	1.1%	Na_2O	-	0.1%
P_2O_5	-	0.2%	K_2O	-	1.1%

Ash Fusion (reducing):

Initial Deformation	1300 Deg. C +

BTU's Per Pound:

Gross BTU/lb (Air Dry)	9,830 BTU/lb
Gross BTU/lb (As Received)	8,475 BTU/lb

(Use 8,400 Btu/# for evaluation purposes)

Calories Per Gram:

Gross Calories/Gram (Air Dry)	5,460 Kcal/Kg
Gross Calories/Gram (As Received)	4,710 Kcal/Kg

Size Consist:	2" x O (approx)
+ 3/8"	7%
- 3/8" + 28 M	48%
- 28 M + 100 M	24%
- 100 M + O	21%

9. COAL COST DATA

Coal costs include the following elements: coal purchase cost at the coal mine and truck haul costs delivered into the coal storage system at the Libby operation. The first cost, coal commodity cost, has the likelihood to be priced as a mine waste product. Thus, the long-term price structure will be assumed to cover the costs to load into trucks and the administrative costs. The commodity cost will be assumed to be a variable amount based on the world energy market for oil and the domestic electric costs. It is logical to assume that in the long run, coal would eventually become competitive with the traditional energy markets.

COAL COST DATA

Commodity	$ 6.00
Loading and Handling	1.50
Administrative	0.50
Truck Haul (1) ($0.13/ton-mile) x 120 miles	15.60
Total Cost F.O.B. to W.R. Grace	$23.60/ton

Note (1): Per quote from Wallace Colville Motor Freight, Inc.

Coal Cost: 16,800,000 Btu/Ton (8,400 Btu/#) = $ 1.23/MBtu

Westar Mining International

Westar Mining
International Ltd

[illegible]

Telephone (604) [illegible]
Telex 04 508723

Bill,
Update on Coal Prices.

October 17, 1983

Mr. John Woodward
W.R. Grace and Co.
P.O. Box 609
Libby, Montana
U.S.A. 59923

Dear John:

As we discussed when I dropped by your office on October 7, the following are some revised prices for our thermal coal products. These are prices that we would be indicating for prompt delivery:

Greenhills Thermal Coal	-	US$18.50/ST
Balmer Thermal Coal	-	US$15.00/ST
Elkview Thermal Coal	-	US$ 8.00/ST

The above prices are quoted in U.S. dollars per short ton, delivered onto trucks or rail cars at the minesites.

I hope that these prices are of some interest, as you can see there has been a considerable softening of thermal coal prices and we do not expect any dramatic changes in the near term. If you have any further questions, give me a call.

Yours truly,

Guy Heywood

Guy Heywood
Marketing Representative

RGH:llt

Mike Ray /
'Cheap BTU's

ELKVIEW THERMAL COAL SPECIFICATIONS

		TYPICAL
Moisture (Total)		15.00
PROXIMATE ANALYSIS: (Air Dry Basis)		
Inherent Moisture	%	1.50
Ash	%	33.00
Volatile Matter	%	18.00
Fixed Carbon	%	47.50
Sulphur	%	0.30
Hardgrove Grindability Index:		105
Calorific Value:		
Gross Air Dry	cal/gm	5,460 (9,830 Btus/lb)
Gross As Received	cal/gm	4.710 8,475 Btus/lb)

Ultimate Analysis:

Carbon	C%	57.90
Hydrogen	H%	3.40
Nitrogen	N%	0.60
Sulphur	S%	0.30
Ash	Ash%	33.10
Oxygen	O%	4.70
		100.00

Ash Analysis:

SiO_2	60.2	P_2O_5	0.2
Al_2O_3	28.9	Na_2O	0.1
Fe_2O_3	3.9	K_2O	1.1
CaO	2.7	TiO_2	1.1
MgO	0.9	SO_3	1.2

Ash Fusion Temperature:

Initial Deformation (Reducing) 1,300 deg. C

Size 2" X 0

LIST OF REFERENCES

- "Montana's Forest Products Industry," Charles E. Keegan III, Timothy P. Jackson, Maxine C. Johnson, Bureau of Business and Economic Research, University of Montana, Missoula, Montana
- "The Cost and Availability of Forest Residue in the Northern Rocky Mountains," Charles E. Keegan III, Bureau of Business and Economic Research, University of Montana, Missoula.

TASK 108: COAL BURNING FACILITIES CONCEPTUAL DESIGN

1. INTRODUCTION

The facilities for the burning of coal to supply the thermal energy for the W.R. Grace mine vermiculite drier are described below as two subsystems; the burner and hot gas handling system and the fuel handling system at the mine. Both of these systems are essentially the same as those described in Task 105 for the wood fueled combustor, only the modifications and differences will be identified here.

2. GENERAL DESCRIPTION

a. The burner and hot gas handling system for coal have the identical components as for the burning of wood. The schematic diagram on Figure 1 for Task 105 shows the system with differences in fuel flow rate, air flow rates and temperatures.

b. The fuel handling and storage system at the mine for the handling of coal is basically the same as the wood handling system and is also represented on Figure 2 for Task 105. The following modifications would be recommended when handling coal:

- A grating known as a "grizzly" should be placed over the truck dump hopper to break up large clumps of frozen coal before they enter the hopper. The openings on the grizzly would be approximately 12 inches by 12 inches.
- If fugitive duct becomes a problem, a water spray ring could be installed at the hopper.
- Frozen coal should be further broken down by a crusher (de-lumper) installed in the vertical chute between the hopper drag chain discharge and the flexible wall belt conveyor. Since the de-lumper would only be required during the winter, the system is set up to allow easy removal of the de-lumper.
- The storage bin has been chosen for its ability to handle hogged wood that is significantly more difficult to get to flow than coal. The sweep auger is not required to be used when coal is stored in the bin and should be de-energized or removed prior to the use of coal.

3. HEAT BALANCE

The thermal energy required for the drier is independent of the fuel used, so the 24.8 million BTU/hr is the same for coal as wood. The heating value of the coal to be burned at the mine is approximately 8,400 BTU/lb. The combustor would require about 3,114 lbs/hr to produce the heat required. Since the heating value for the coal is higher and the moisture content is lower, the gas temperature will be higher than that for wood. The 1800 degrees F exhaust gas temperature will be higher than that for wood. The 1800 degrees F exhaust gas temperature must be cooled with a greater volume of blending air. The gas flow rates, the temperatures and the pressures are shown in the table for coal in Figure 1 for Task 105.

4. PROCESS DIAGRAM

Figure 1 of Task 105 shows the process diagram for the combustor and air handling system. Figure 2 of Task 105 is also applicable to coal with the differences identified in item 2 (b) above.

5. SITE LAYOUT

Figure 4 of Task 105 applies to the use of coal as well as wood.

6. FUEL SPECIFICATION

	Typical
Moisture (Total)	15.0%
Proximate Analysis (Air Dry):	
Inherent Moisture	1.5%
Ash	33.0%
Volatile Matter	18.0%
Fixed Carbon	47.5%
Sulphur	0.3%
Hardgrove Grindability	105

Ash Analysis

SiO_2	-	60.2%
CaO	-	2.7%
Al_2O_3	-	28.9%
MgO	-	0.9%
Fe_2O_3	-	3.9%
SO_3	-	1.2%
TiO_2	-	1.1%
Na_2O	-	0.1%
P_2O_5	-	0.2%
K_2O	-	1.1%

Ash Fusion (reducing):

Initial Deformation	1300 Deg. C +

BTU's Per Pound:

Gross BTU/lb (Air Dry)	9,830 BTU/lb
Gross BTU/lb (As Received)	8,475 BTU/lb

(Use 8,400 Btu/# for evaluation purposes)

Calories Per Gram:

Gross Calories/Gram (Air Dry)	5,460 Kcal/Kg
Gross Calories/Gram (As Received)	4,710 Kcal/Kg

Size Consist:	2" x 0 (approx)
+ 3/8"	7%
- 3/8" + 28 M	48%
- 28 M + 100 M	24%
- 100 M + 0	21%

7. SOIL DATA

Based on the foundation design for the existing processing facilities, spread footings would be used. For conceptual design purposes, a 3,500 pounds per square foot soil bearing pressure will be used.

8. WEATHER DATA

Source: Climatological Data Annual Summary, Montana 1982, Volume 85, Number 13, National Oceanic and Atmospheric Administration, Asheville, North Carolina 28801.

Annual Precipitation: 20 inches

Temperature Extremes and Freeze Data °F:

Highest	97°
Lowest	-16°

Cooling Degree Days - Base 65°F - 212 Annual
Average Temperature - Annual 45°F
Winter 27°F
Summer 64°F

9. LICENSING AND PERMITTING INFORMATION

- The particulate emissions must not exceed 25 tons per year.
- Ash disposal to be in mine tailings area.
- All waste water must be disposed in the existing mine waste water system.
- Plant water to be supplied from existing boiler water supply facilities.

10. PLANT OPERATING CRITERIA

The combustor operation with coal is the same as wood with the exception that, since coal has a greater density and higher heating value, the same storage volume will provide about 12 days of storage. (A smaller storage bin could be used with some capital cost savings.)

11. PLANT OPERATING STAFF

The fluidized bed combustor will have automatic controls for fuel feed and combustion so that only periodic checks would be required. The fuel unloading and storage at the mine would require about one hour per day of operator surveillance. Since the demands for operator time are relatively small, the extra work load could be absorbed by the current staff at the mine with the proper training.

12. PLANT MAINTENANCE

With the exception of the controls, the fuel handling and storage and combustor systems have relatively conventional components that lend themselves to standard preventative maintenance practices with which the current mine staff is familiar.

13. CONCEPTUAL DRAWINGS AND SKETCHES

Refer to Task 105.

TASK 109: PRELIMINARY COAL SUPPLY SYSTEM ECONOMIC PERFORMANCE

1. INTRODUCTION

In order to develop a meaningful comparison of wood fuels to coal, a coal energy system will have to be designed and priced out. The system must meet the same performance requirements as required for the wood fuel.

2. PURPOSE AND TASK DESCRIPTION

Based on the conceptual design for the coal burning facilities (Task 108) and cost of coal delivered to Libby (Task 107), the preliminary economic performance characteristics will be prepared for the coal based energy supply system.

3. COAL SUPPLY SYSTEM DESCRIPTION

The economic performance for the coal supply system will be based on the following conceptual design:

- Purchase coal from Crows Nest Mine, Fernie, B.C.
- Contract truck hauling to Libby, Montana.
- Unload coal into a coal silo on top of the mountain at the W.R. Grace & Co. processing plant.
- A fluidized bed burner will be used to burn the coal to produce hot gas for drying vermiculite.
- Ash will be disposed of in the mining operation waste piles.

4. FACILITY PERFORMANCE CHARACTERISTICS

Dryer Fuel Requirements

Annual Fuel Quantity 570,000 gallons oil
Annual Energy Rqmt. @ 148,000 Btu/gal #5 oil
= 8.44×10^{10} Btu's

Annual Coal Rqmts. @ 8,400 Btu's per pound (16.8×10^6 Btu/ton) = $\frac{8.44 \times 10^{10} \text{ Btu} \times .95 \text{ boiler efficiency}}{16.8 \times 10^6 \text{ Btu/ton} \times 0.90 \text{ boiler efficiency}}$
= 5,303 tons coal per year

Average Monthly Fuel Rqmt.
= $\frac{5{,}303 \text{ tons}}{12 \text{ mo.}}$ = 442 tons

Average Weekly Fuel Rqmt.
= $\frac{5{,}303 \text{ tons}}{50 \text{ weeks}}$ = 106 tons

Average Daily Fuel Rqmt.
= $\frac{106 \text{ tons}}{5 \text{ days}}$ = 21.2 tons per day

Steam Fuel Requirements

Annual Fuel Quantity 315,000 gallons
Annual Energy Rqmt. @ 148,000 Btu/gallon #5 oil
= 4.662×10^{10} Btu's

Annual Coal Requirements @ 8,400 Btu per pound (16.8×10^6 Btu/ton) = $\frac{4.662 \times 10^{10} \times 0.95 \text{ boiler efficiency}}{16.8 \times 10^6 \text{ Btu/ton} \times 0.90 \text{ boiler efficiency}}$
= 2,929 tons coal per year

Average Monthly Fuel Requirement
= $\frac{2{,}929 \text{ tons}}{5 \text{ months}}$ = 586 tons per month

Average Weekly Fuel Requirement
= $\frac{2{,}929 \text{ tons}}{5 \text{ mos.} \times 52 \text{ weeks/12}}$ = 135.2 tons per week

Average Daily Fuel Requirement
= $\frac{135.2 \text{ tons per week}}{5 \text{ days}}$ = 27 tons/day

Electric Fuel Requirements

Annual Fuel Requirement = 34,000,000 KwHr
Annual Fuel Quantity @ 12,000 Btu/KwHr
for coal fueled power plant
= 34,000,000 KwHr x 12,000 Btu/KwHr

16,800,000 Btu/ton fuel
= 24,286 tons coal per year

Average Monthly Fuel requirement

$$= \frac{24,286 \text{ tons}}{12} = 2,024 \text{ tons/month}$$

Average Weekly Fuel Requirement

$$= \frac{24,286 \text{ tons}}{50 \text{ weeks}} = 486 \text{ tons/week}$$

Average Daily Fuel Requirement

$$= \frac{486 \text{ tons}}{5} = 97.14 \text{ tons per day}$$

5. SYSTEM ECONOMIC PERFORMANCE CHARACTERISTICS

Coal from Fernie, B.C. is a waste product of a high value metallurgical coal. The low value thermal coal is readily available because of limited local market conditions in the vicinity of the coal mine. The long-term strategy for coal sales to W.R. Grace would be to offer the coal at very low prices initially to convert W.R. Grace to coal. Once coal use is established, say two to five years, then gradually increase the coal price to the next competitive energy resource, wood fuel.

Transportation costs over the 120 miles will establish a minimum base coal price. In the long term, the minimum coal price would include coal loading and handling at the mine, administrative costs and truck haul costs. Transportation cost escalations would be subject to the cost of fuel oil over the years to come. The international border between the United States and Canada has the potential of interferring with coal shipments. This possibility seems remote at this writing.

6. COAL SUPPLY SYSTEM COST PERFORMANCE BY SUBSYSTEM

(DRYER FUEL)

		Annual Cost
Commodity: F.O.B. Fernie, B.C.		
5,303 tons/year x $8 per ton		$42,424.00
Truck Transportation: 120 miles @ $0.13/ton mile) $15.60/ton x 5,303 tons		82,727.00
Storage and Handling		
Capital Recovery (15%, 15 years, $264,920)	$45,306	
Maintenance Cost (1% x $264,920)	2,649	
Annual Power Costs (same as wood)	2,682	
Sub-total		50,637.00
Fuel Conversion (same as wood)		157,026.00
Ash Disposal (33% x 5,303 tons @ $1/ton)		1,750.00
Annual Cost of Fuel		$334,564.00
Cost Per Ton		$63.09
Cost Per Million Btu (@ 8,400 Btu/#)		$3.76

LIST OF REFERENCES

Michael D. Ray, P.E., Plant Engineer
Construction Products Division
W.R. Grace & Co.
Libby, Montana

Guy Heywood, Marketing Representative
Westar Mining International
Vancouver, B.C.

Task 110: OIL SUPPLY SYSTEM AND ECONOMICS

1. INTRODUCTION

W. R. Grace has been a traditional user of fuel oil for their vermiculite processing operation at the mountain top location. The last decade's rapid fuel oil cost increases combined with unstable world oil market conditions has led W.R. Grace to investigate other alternative energy suppliers.

2. PURPOSE AND TASK DESCRIPTION

This section will document the current W.R. Grace oil-based energy supply system. The location of the oil supplier(s) will be identified along with the transportation/storage and delivery systems. The available fuel quantities will be identified along with the impacts of varying demands and oil specifications. The product of this task will be a cost/performance analysis of the current fuel oil supply system broken down to the commodity, transportation, fuel handling and energy conversion facilities.

3. OIL SUPPLY SYSTEM DESCRIPTION

The vermiculite mine purchases its oil from regional fuel oil wholesalers on a competitive bid basis. Bids are secured as dictated by the changes in the fuel oil market prices. In addition, propane burning capability was added to the mine to improve price competition for fuel oil and as a hedge to the unstable oil market. The installation of propane burning capability resulted in a significant cost reduction in fuel oil purchases. The current fuel oil supplier is Tri-State Oil Company located in Spokane, Washington.

Fuel oil is delivered by tanker truck to the W.R. Grace mine fuel oil storage tanks. Transportation costs are included in the purchase price. W.R. Grace modified their fuel oil burners to burn the lower cost #5 fuel oil, diesel and propane in the last three years. The fuel oil specification varies in a narrow range with each specific delivery. The current price of fuel oil is $0.664 per gallon of #5 fuel oil F.O.B. to W.R. Grace & Co. mine.

TASK 111: ENVIRONMENTAL ASSESSMENT

For a conceptual design process to be complete, an environmental assessment has to be prepared to ensure the economic viability of proposed energy options.

The permanent fuel storage and energy conversion facilities to be constructed will be at or near existing vermiculite processing facilities. These existing processing facilities have been in existence since the mine was opened 30 years ago. This is a well established operation and enjoys a fine history of environmental control.

The in-woods forest residue operation will be performed to specifications of the forest owner/manager such as the U.S. Forest Service and Montana Department of Forestry.

2. PURPOSE AND TASK DESCRIPTION

The purpose of this task is to identify potential environmental roadblocks and to prepare an initial, comparative environmental assessment of the three energy sources under evaluation. The product will be a comparative analysis by environmental classification to be used for planning.

3. SYSTEMS DESCRIPTIONS FOR ENERGY SOURCE OPTIONS

For oil description, refer to Task 110, paragraph 3.0
For wood description, refer to Task 106, paragraph 3.0
For coal description, refer to Task 107, paragraph 3.0

4. COMPARATIVE ANALYSES BY CATEGORY

Earth (Geology and Soils)

The soil bearing capability of the site is suitable for spread footings. Compared to the existing mining operation on-site, all construction activities for alternative energy facilities will be insignificant. The existing mine drainage system can handle any potential construction impacts. The impact on geology and soils will be the same regardless of the energy source option (oil, wood or coal).

Air Quality

Conversion of the existing burner from oil to wood fuel will result in a change in pollution emissions, including a significant increase in particulate emissions. Pollution equipment will be required to control the rate of particulate emissions, and an air quality permit must be received from the State of Montana prior to construction. A wood-fired burner fueled with forest residue will eliminate in-the-woods burning of slash. Because of the burner's pollution controls, the overall air quality of the area will not be affected.

Conversion to coal would also require pollution control equipment to be installed and an air quality permit be secured from the State of Montana prior to construction. Low sulfur coal will be used.

The location of this site is not within a sensitive area such as a Class I area.

The increase in traffic as a result of fuel transportation will be small and will not have a significant air quality impact. Other secondary impacts are not foreseen.

Water

The conversion to coal or wood as fuel would not require any changes to the existing water supply and waste water systems.

Flora and Fauna

Conversion of burner fuel will have no impact on flora and fauna except in the forest where forest residue collection operations will have a positive impact on forest stands.

Using forest residue will eliminate the need to dispose of the residue by traditional burning practices. Forest Residue recovery will also reduce the breeding grounds for insects that damage the forests. Finally, forest residue recovery will allow for the conversion of forest stands to desirable specie.

Noise

Plant operation will be the same regardless of the fuel type. Truck traffic will be greater for wood than coal, and the least for oil. However, the existing truck traffic in Libby is two orders of magnitude greater than traffic created by transportation of any of the alternative fuels.

Light and Glare

No impact.

Land Use

The site of the existing mining operation will be used for the fuel storage and conversion facilities. Wood waste in-the-forest recovery operations will allow the forest manager to implement forest improvement program objectives. No changes to existing land use are foreseen for the energy options under evaluation.

Natural Resources

Oil, which is presently being burned, is a non-renewable resource and is subject to world market impact. If the plant is converted to wood, it would be utilizing a renewable resource that has no exisiting market. (Forests in the Kootenai National Forest area produce 1.8 million tons per year of waste.) If coal is burned, then the fuel supply would be a non-renewable resource. Extensive reserves are available, with the closest coal being a by-product of a metallurgical coal mine.

Risk of Upset

The only significant difference from oil is the potential of dust explosions in the wood and coal fuel storage silos. This event is rather remote in occurance, and standard detection and prevention devices are available. No risk to the general public is seen.

Population and Housing

The peak construction force is estimated at 10 personnel. It is anticipated that all of the construction force would be from the local labor force.

The forest residue operating staff will be hired from the existing labor pool in the Libby area.

Transportation

Because of the relatively small incremental truck traffic created by the alternative energy options, no significant transportation impacts are foreseen.

Public Services

No impacts to public services are foreseen.

Energy

Oil and coal are non-renewable and important energy resources. Wood residue is a new energy resource not presently being utilized, and is renewable.

Project Economics

Oil and coal are purchased outside the country (coal supply from Canada). If forest residue is utilized, revenue from fuel recovery operations would stimulate the local Libby economic system.

Utilities

No impacts to existing utility facilities are foreseen.

Human Health

No significant impacts are foreseen.

Aesthetics

The proposed conversion would not aesthetically impact the existing industrial site. Using wood waste for fuel would have a positive impact on forest stands.

Recreation

As with aesthetics, forest residue clean-up would have a positive impact to recreation in the area because of improved forest stands.

Archeological/Historical

No significant impacts foreseen.

Cogeneration

The potential exists to incorporate cogeneration by producing electricity and using steam and hot gases as by-products. This could improve overall utilization of energy resources.

Alternative Sites

Based upon evaluation of topography in the vicinity of the vermiculite mining operation, the steep terrain limits the alternative energy conversion sites to two locations: (1) mountain-top site adjacent to existing processing facilities, and (2) mountain base site adjacent to existing settling ponds. This would require relocating the vermiculite processing facility.

Both sites are located on W.R. Grace & Co. property and on existing mining operating property.

The most practical site for the long-term wood fuel storage/reparation and handling facility is adjacent to the vermiculite storage and shipping facilities. This is an existing industrial site and is on W.R. Grace & Co. property.

Ash Disposal

Oil	Forest Residue	Coal
No ash	2% x 12,000 tons	33% x 5,303 tons/yr
Disposal	= 240 tons/year	= 1,750 tons/year

The mine processes 3,400,000 tons of ore and waste per year. Over 93% is waste and is accumulated in the mining tailing areas. No significant impact is foreseen in disposing of either wood or coal ash in the existing mining tailings.

Public Benefit

The W.R. Grace vermiculite mining operation is a major employer in the Libby area. Compared to the present oil burning plant, conversion to wood fuel would increase local employment by 6 people. The coal option would increase employment by one.

To the Libby area, wood fuel generates the most public benefits. These benefits are as follows:

Resulting Public Benefits

- Utilizes unused forest residues to substitute for fossil energy uses.
- Provides new stable jobs in the Libby area.
- Improves environment by reducing slash burning.

- Reduces the out-of-state cash drain required to import energy for the operation of industry in Montana.

- Increases the local tax base and generates additional funds to support governmental services.

- Creates local investment opportunities.

- Utilizes established forest products industry labor skills to recover the bioenergy fuels.

Description of Those Who Would Directly Benefit

- Five of fifteen new jobs would be created in the recovery, preparation and transportation of the forest residues. These positions would come from the existing forest products labor force in the Libby area.

- Five new jobs will be created to operate and maintain the bioenergy conversion facilities. Seventy-five percent of these positions would come from the local Libby area labor pool.

- The forest stand owners/managers will have a way to dispose of a portion of their logging and forest residues. They will have the opportunity to conduct aggressive forest management practices resulting in long-term increased commercial timber production in the Libby area. This will then enhance the existing Libby forest industry timber resource. base.

- A new, stable local forest products industry will result, adding a stabilizing economic outlook to the local Libby economy.

- The geographic area affected would be generally defined by the economics of transportation, forest residue recovery and bioenergy conversion. Generally, the maximum haul distance would be about 70 to 100 miles from Libby.

- The new tax base would generate about $20,000 to $50,000 annually in property taxes and new income taxes to support state and local government services. This would be to the benefit of the Libby area citizens.

- Using a three-to-one multiplier, the 10 to 20 new jobs would provide for 30 to 60 support jobs in the Libby area, creating new work for a younger labor pool in the Libby area. The young will not have to leave Libby to find employment.

Products for Public Use Resulting from This Project

- In addition to the preceding benefits, the establishment of a cost-effective, reliable bioenergy industry in the Libby area would provide the opportunity for residential and commercial conversion to bioenergy fuels for heating purposes.

- Fire wood would become more available and accessible as a direct result of forest residue recovery operations.

Public Opinion

The principal commerce in the Libby area is the forest products industry, followed by the vermiculite mining operation. The last decade has seen a major upset and unsettling events in the traditional lumber and paper markets. The addition of a new industry, such as bioenergy fuels that utilize the waste products of the existing forest products industry, will provide a stabilizing influence to the local Libby economy, and public opinion will be favorable. In any event, public opinion will support the continued operation of the vermiculite operation regardless of fuel used.

5. CONCLUSIONS AND RECOMMENDATIONS

No significant environmental impacts were discovered to preclude the orderly development of the proposed alternative energy resources. It is recommended that the investigation continue.

TASK 112: INSTITUTIONAL INTERFACES

1. INTRODUCTION

Early in an alternative option investigation, certain administrative requirements may involve significant lead times or document preparation. These potential requirements can eliminate some options. The most likely impacts would be lead times and expensive document preparation that make it impossible to meet the overall schedule requirements of project development.

2. PURPOSE AND TASK DESCRIPTION

The purpose of this task is to identify all significant institutional interfaces required for each energy option. A list of major permits, licenses and agencies involved with the development and long-term operation for each energy option will be prepared. Personal contacts will be made to prepare for the submission of applications. The agency's primary concerns will be documented and pertinent information recorded in support of future licensing.

3. SYSTEMS DESCRIPTIONS FOR ENERGY SOURCE OPTIONS

Oil System Description - Refer to Task 110, paragraph 3.0
Wood System Description - Refer to Task 106, paragraph 3.0
Coal System Description - Refer to Task 107, paragraph 3.0

4. LIST OF INSTITUTIONAL INTERFACES BY ENERGY OPTION

Institution	Wood	Coal
Department of Health and Enfironmental Sciences Air Quality Bureau	X	
Dept. of Environmental Quality	X	

5. LIST OF PERMITS, LICENSES BY ENERGY OPTION

Permit Title	Wood	Coal
Letter Requesting Determination of Applicability to PSD Permit	X	X
If applicable, PSD Permit	X	X
Montana State Air Quality Permit	X	X

6. AGENCY CONTACT NOTES/MEETING MINUTES

Department of Health & Environmental Sciences
Air Quality Bureau
Capitol Station

Helena, Montana 59620
Contact: Mr. Chuck Homer
Telephone: 406/444-3454

Mr. Homer felt that the Montana Air Quality Permit would be the only permit required. The EPA-PSD permit is issued by the State and is included in the State permit process. If the proposed conversion causes a potential emissions increase of 25 tons of particulates, or any other significant increase in emission rates, a state air quality permit would be required. Potential emissions are calculated without consideration of pollution equipment. Mr. Homer will send a permit application and a copy of the state regulations.

The Department of Environmental Quality of Helena, Montana (406/444-3472) was also contacted. This is not a regulatory agency, but did have permit information and will send the state permit index. From the index, we can be certain that there are no permit requirements in addition to the State Air Quality Permit. This agency did mention, for information only, that due to topography, Libby's air quality (particulates) is the worst in the state.

7. LIST OF AGENCIES' PRIMARY CONCERNS

Agency	Concerns
Dept. of Health & Environmental Sciences Air Quality Bureau	Using wood or coal as fuel will cause emissions of more than 25 tons per year of particulates. An air quality permit will probably be required.

8. LIST OF PERSONS CONTACTED BY AGENCY

Dept. of Health & Environmental Sciences
Air Quality Bureau
Mr. Chuck Homer

9. COPIES OF PERMIT APPLICATIONS

Permit Title	Lead Agency
Refer to Appendix C.	

10. LICENSING AND PERMITTING PROCEDURES

Montana State Air Quality Permit & PSD

- Submit letter requesting determination of applicability to PSD.
- Submit technical information and application for State Air Permit.
- Typical time for State permit process is 60 days and requires public notice.

. PSD permit requires more time.

MEMORANDUM

TO: Dave Van Horsett

FROM: Jerrie Little

SUBJECT: Task 112 - Permit Requirements for Woodwaste/Coal Burner at Libby, Montana

DATE: July 25, 1984

In response to your July 24 request regarding the conversion of W.R. Grace's oil fired burner to coal or wood waste, I have determined the following preliminary information:

Permit Requirements

Montana State Air Quality Permit - required for both coal and wood waste.

(Note: I requested a copy of the Montana permit index to be mailed to me at your office. This will identify any additional requirements, though there probably are not any.)

Regulatory Agency Contacts

Department of Health & Environmental Sciences
Air Quality Bureau
Capitol Station
Helena, Montana 59620
Contact: Mr. Chuck Homer (406/444-3673)

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Contacted the Department of Environmental Quality at Helena, Montana (406/444-3472). This is not a regulatory agency, but did have permit information and will send the state permit index. From the index, we can be certain that there are no permit requirements in addition to the state air quality permit. This agency did mention, for information only, that due to topography, Libby's air quality (particulates) is the worst in the state.

LIST OF REFERENCES

TASK 113: PRELIMINARY COMPARATIVE ECONOMIC PERFORMANCE

1. INTRODUCTION

The economic analysis is the culmination of the first two milestone activities. The economic model attempts to set dollar amounts for each of the component investigated. This economic model then provides the managers and decision-makers with the ability to evaluate the development of strategy to configure a competitive bioenergy fuel supply system.

2. PURPOSE AND TASK DESCRIPTION

The purpose of this task is to prepare a preliminary comparative economic performance analysis of the three energy sources under consideration: oil, coal and wood. The base case, oil, will be defined to establish the base line position of policy development. A narrative discussion presenting the relative position of the three energy sources will be prepared. This subjective analysis sets the background to establish the exact scope of work for Phase II (Milestones 3,4 and 5) based on the comparative economic analysis developed from data prepared in Milestone No. 1).

The product of this task will be a subjective comparative risk analysis of the following items: resource base, foreign influence, manufacturing, transportation, labor, price stability, environmental, capital and operations. This will be followed by a traditional economic analysis to calculate relative cost performance of the three energy sources. Finally, using the economic models, a strategy will be developed to configure alternative systems that are competitive to each other.

From this process, conclusions and recommendations will evolve and will be documented in the next task.

3. SYSTEM DESCRIPTIONS FOR ENERGY OPTIONS

Oil System - Refer to Task 110, paragraph 3.0
Coal System - Refer to Task 106, paragraph 3.0
Wood System - Refer to Task 107, paragraph 3.0

4. BASE CASE - OIL SUPPLY SYSTEM

Dryer annual fuel oil requirements	570,000 gallons
#5 fuel oil price (1984)	$0.664/gallon
Term of oil supply contract	Spot market
Pricing terms	Fixed

5. COMPARATIVE RISK ANALYSIS

Oil	Wood	Coal

Resource Base

Oil	Wood	Coal
Domestic & foreign non-renewable supplies	Local renewable resources	Domestic & foreign non-renewable supplies
Foreign Influence		
Price & supply subject to foreign impacts	No foreign influence, all domestic resources	Canadian coal
Technology		
Established existing technology	Existing technology	Existing technology
Manufacturing		
Product price based based on value & supply	Product price based on cost manufacture fuel	Product price based market value
Labor		
Minor part of product price	30% of fuel price escalation keyed to independent forest products industry labor rates	30% of transportation cost, escalation keyed to truckers' union rates.
Transportation		
Minor part of product price	15% of fuel price escalation subject to independent forest products labor rates	70% of base price, escalation subject to truckers union rates
Price Stability		
Subject to world market influences. Not stable in last decade. Uncertainty	Fuel price based on manufacturing a product from a local forest residue resource pricing predictable. Highly competitive independent labor market.	Commodity price is variable. Transportation component is stable.
Environmental		
Base case utilize low sulfur fuels	Positive impacts, major liabilities foreseen	With low sulfur coal, no major liabilities foreseen

Capital		
Current facilities installed at suppliers & mining location	New capital required	New capital required
	Forest Recovery $269,200 Fuel Storage/Handling $544,800 Fuel Storage/Handling at Mine $269,920 Fuel Burner $646,250	Fuel Transportation $100,000 Fuel Storage/Hndling $264,920 Fuel Burner $646,250 Coal Conversion $188,830
	$1,455,970	$1,200,000
Operations		
One operator per shift at mine	8 men in-woods recovery operations	One truck driver
	Two men at fuel storage	One operator per shift at mine
	One operator per shift at mine	
Maintenance		
Fuel supplier performs own maintenance	Fuel supplier performs own maintenance	Truck-trail maintanance by mine or contract hauler staff
Burner maintenance by mine staff	At-mine fuel storage & burner maintenance by mine staff	At-mine fuel storage and burner maintenance by mine staff

6. COMPARATIVE ECONOMIC ANALYSIS

The initial comparative analysis represents the results of the preliminary conceptual work prepared to date. This analysis will be followed by three additional economic analyses to develop competitive energy supply systems. The four economic analyses are as follows:

A - Initial Case: Dryer Fuel Only
B - Initial Case: Total Mine Energy
C - Competitive Case: Dryer Fuel Only
D - Competitive Case: Total Mine Energy

6.1 STRATEGY A - INITIAL CASE: DRYER FUEL ONLY

	Oil	Wood	Coal
Resource Rights Contract Term	-0-	-0-	-0-
Annual Quantity Required	Spot Market to 1 year	20 Year	Spot Market to 5 years
Commodity Price (F.O.B. Mine)	$0.644/gal	$50.80/ton	$23.60/ton
Annual Fuel Cost*	$367,080	$609,600	$109,180
Long-Term Fuel Handling/Storage	In-place fuel storage	Provide by fuel supplier	Located at coal mine
Facilities Capital Cost	-0-	$644,800	$188,830
Annual Fuel Storage Cost* 10 Years @ 15%	-0-	$108,553	$ 37,628
Labor*	Base	$ 25,000	---
Annual Operating Cost 100 HP @ 30% P.F.	Base	$ 7,831	---
(Sub-total)	(Base)	($141,384)	($ 37,628)

Note: * This indicates which numbers are used to add to make the total cost.

	Oil	Wood	Coal
AT-MINE FUEL STORAGE HANDLING COSTS			
Labor	Base	$ 12,500 (1/2 man year)	$ 12,500
Capital	Base	$264,920	$264,920
Annual Capital Recovery Cost* (10 Years @ 15%)	Base	$ 52,786	$ 52,786
Annual Maintenance @ 1% of Capital*	Base	$ 2,649	$ 2,649
Annual Operating Cost 50 HP @ $0.04 @ 30% P.F.*	Base	$ 3,916	$ 3,916
(Sub-total)	(Base)	($ 71,851)	($ 71,851)
ANNUAL BURNER COST			
Capital	Base	$646,250	$646,250
Annual Capital Recovery (10 Years @ 15%)	Base	$128,767	$128,767
Annual Burner Maintenance (1% of Capital)		$ 6,463	$ 6,463
ANNUAL OPERATING COSTS			
Connected HP	50 HP	150 HP	100 HP
Annual Power Cost @ $0.04/KwH & 30% P.F.	$ 5,256	$ 15,768	$ 10,512
(Sub-total	($ 5,256)	($150,998)	($145,742)
TOTAL ANNUAL FUEL COST	$373,336	$973,833	$364,401

6.1 STRATEGY B - INITIAL CASE: TOTAL MINE ENERGY

To take advantage of lower unit cost at higher forest residue production rates, the energy supply for the entire mine was considered. This increases the annual wood fuel requirement to the optimum production level for the forest residue recovery operation. First, the total annual fuel requirements for the entire mine were calculated by fuel option and unit fuel cost defined from data prepared earlier in this report. Armed with this information, the following comparative economic analysis was prepared:

	Oil	Wood	Coal
Resource Rights	-0-	-0-	-0-
Contract Term	Spot to 1 Yr.	20 Year	Spot to 5 Yrs.
Annual Quantity Requirement	885,000 gal. 34,000,000	73,856 tons @ 9 million Btu/ton	35,835 tons @ 17 million Btu/ton
Commodity Price	$0.664/gallon $0.02.9/KwH	$30.00/ton	$20.60/ton
Annual Commodity Cost	$587,640 (oil) $986,000 (elec) $1,573,640	$2,115,680	$738,201
Long-Term Fuel Storage	Outside Libby Area	In Libby Area	Fernie, British Columbia
Capital	Base	$544,800	$188,830
Annual Capital Recovery (10 Years @ 15%)	Base	$108,553	$ 37,628
Annual Maintenance	Base	$ 5,448	$ 1,883
Labor	Base	$ 25,000	---
(Sub-total)	(Base)	($139,001)	($ 39,511)
AT MINE FUEL STORAGE AND HANDLING COSTS			
Labor	Base	$ 12,500	$ 12,500
Capital	Base	$264,920	$264,920
	Oil	Wood	Coal
Annual Capital Recover (10 Years A 15%)	Base	$ 52,786	$ 52,786
Annual Maintenance			

@ 1% of Capital	Base	$ 2,649	$ 2,649
(Sub-total)	(Base)	($ 67,935)	($ 67,935)
BURNER OPERATION			
Capital Cost	Base	$646,250	$646,250
Capital Recovery (10 Years @ 14%)	Base	$128,767	$128,767
Burner Maintenance	Base	$ 6,463	$ 6,463
Annual Operating Cost (electric power)	$ 5,256	$ 15,768	$ 10,512
(Sub-total)	($ 5,256)	($150,998)	($145,742)
COGENERATION			
Plant Capital	Base	$7,000,000	$7,000,000
Capital Recovery (15 Years @ 15%)	Base	$1,197,120	$1,197,120
Maintenance	Base	$ 300,000	$ 300,000
Operations	Base	$ 300,000	$ 300,000
Electric Sales	N/A	$1,153,000	$1,153,000
Electric Fuel Requirement	N/A	29,839 tons	13,565 tons
Fuel Cost	---	$30/ton	$20.60/ton
Fuel Cost	---	$895,170	$279,439
(Sub-total)	(Base)	($1,539,290)	($923,559)
Annual Mine Energy Cost	$1,578,896	$4,012,904	$1,914,948

COGENERATION

Generation Capacity Requirement for Mine	6,000 Kw
Installed Capacity	7,500 Kw
Gross Electric Generation 8,760 Hr. x 7,500 Kw x .9 x .9	53,217,000 KwH
Less Mine Energy Requirements	(34,000,000 KwH)
Net Extra Energy Sales	19,217,000 KwH

ELECTRIC FUEL REQUIREMENT FOR EXTRA POWER SALES (1)

Wood: $\frac{19,217,000 \text{ KwH} \times 14,000 \text{ KwH}}{9,000,000 \text{ Btu/Ton}} =$ 29,893 tons/yr

Coal: $\frac{19,217,000 \text{ KwH} \times 12,000 \text{ KwH}}{17,000,000 \text{ Btu/ton}} =$ 13,565 tons/yr

7.5 mw Plant	- $9,000,000 Total Capital	
	- Annual Capital Recovery 15 Years @ 15%	$1,536,000
	- Operating & Maintenance Exp.	800,000
	- Fuel Cost - See Option under Consideration	

ANNUAL FUEL REQUIREMENTS SUMMARY

	Coal	Wood
Dryer (570,000 Gal)	5,303	13,706*
Process Steam (315,000 Gal)	2,929	7,571
Electric Energy (34,000,000 KwH)	24,286	62,889
Sub-total	32,518 tons	74,166 tons
Extra Electric Sales	13,565 tons	29,893 tons
TOTAL	46,083 tons	104,059 tons*

Note (1): Fuel requirement to generate power above energy used by mill.

* 12,000 tons were used for dryer in preliminary tasks, 72,000 tons were used for optimum forest residue equipment production rate. Note that this rate is similar to the total mine energy requirements.

ALTERNATE BIOENERGY FUEL SUPPLY SYSTEMS

Base System		Forest Residue Recovery	$/Ton F.O.B. Fuel Storage Yard
(A)	:	Harvesting Stagnated Lodgepole Stands (3-Year Supply)	$30 to 50/ton
(B)	:	Logging Residue Recovery	$20 to 30/ton
(C)	:	Pulp Logs Not Chipped	$15/ton

Sawmill Waste Wood ($2 per ton for commodity)

(D) Domestic
Sawmills: 15 sawmills in 90-mile haul

	distance (St. Regis sawmill not included)	$7 to 14/ton
(E) Canadian Sawmills:	12 sawmills in 100-mile haul distance	$9 to 15/ton

FUEL PRICING STRATEGY

Source		Reserves Available	$/Ton	$
A	10%	150,000 TPY	$40/ton	$ 4.00
B	--	1,500,000 TPY	$25/ton	
C	--	100,000 TPY	$15/ton	
D	90%	150,000 TPY	$10/ton	9.00
E	--	200,000 TPY	$12/ton	
	100%	1,950,000 TPY		$13/ton

6.2 ECONOMIC COMPARATIVE ANALYSIS

This section develops a comparative economic analysis for alternative wood fuel supply systems. This is to establish the range of economic cost performance for alternative wood fuel supply systems.

	Wood	Wood	Wood
	A	10%A-90%D	D
Resource Rights	-0-	-0-	-0-
Annual Quantity Required	12,000 tons	12,000 tons	12,000 ton
Commodity Price F.O.B. Fuel Storage	$ 50.80	$ 13.00	$ 10.00
Annual Cost*	609,600	156,000	120,000
Long-Term Fuel Handling/ Storage Facility	544,800	544,800	544,800
Annual Fuel Storage Cost: 10 Years @ 15%*	108,553	108,553	108,553
Operator*	37,000	37,000	37,000
Equipment Maintenance (1% Capital*)	5,448	5,448	5,448
(Sub-total)	($139,001)	($139,001)	($139,001)
AT MINE FUEL STORAGE			
Handling Capital	$264,920	$264,920	$264,920
Annual Capital Recovery (10 years @ 15%)	52,786	52,786	52,786
Equipment Maintenance (1% capital)*	2,649	2,649	2,649
Labor Allowance*	12,500	12,500	12,500
(Sub-total)	($67,935)	($67,935)	($67,935)

(Note: *indicates which numbers are added to make the total.)

	Wood	Wood	Wood
Burner Capital	$646,250	$646,250	$646,250
Annual Capital Recovery 10 Years @ 15%	128,767	128,767	128,767

Annual Burner Maintenance 1% of Capital*	$6,463	$6,463	$6,463
Operating Cost			
Connected HP	150 HP	150 HP	150 HP
Ave Running HP	50 HP	50 HP	50 HP
Annual Power Cost $0.04/KwH x 8760 Hr x 50% Load Factor	$6,526	$6,526	$6,526
(Sub-total)	($141,756)	($141,756)	($141,756)
TOTAL	$958,292	$604,692	$468,692

6.3 ECONOMIC COMPARATIVE ANALYSIS (1984) TOTAL MINE ENERGY REQUIREMENTS

	Wood	Wood	Wood
	A	10%A-90%D	D
Resource Rights	-0-	-0-	-0-
Contract Term	20 Years	Mix of Spot to 20 Years	Mix of Spot to 20 Years
Annual Quantity	73,856 tons	73,856 tons	73,856 tons
Commodity Price	$30.00/ton	$13.00/ton	$10.00/ton
Annual Commodity Cost*	$2,215,680	$960,128	$738,560
Long-Term Fuel Handling/Storage	$544,800	$544,800	$544,800
Annual Capital Cost 10 Years @ 15%	$108,553	$108,553	$108,553
Operator	$37,000	$37,000	$37,000
Equipment Maintenance 1% Capital	$5,448	$5,448	$5,448
(Sub-total)*	($139,001)	($139,001)	($139,001)
Mine Fuel Storage*	$67,935	$67,935	$67,935
Burner Cost*	$141,756	$141,756	$141,756
Cogeneration Plant	$7,000,000	$7,000,000	$7,000,000
Captial Recovery 15 Years @ 15%*	$1,197,120	$1,197,120	$1,197,120
O & M Expense*	$600,000	$600,000	$600,000
Electric Sales @ $0.06*	(1,153,000)	(1,153,000)	(1,153,000)
Electric Fuel Rqmt.	29,839 tons	29,839 tons	29,839 tons
Fuel Cost	895,170	387,907	298,390
ANNUAL MINE ENERGY COST	$4,103,662	$2,340,847	$2,029,762

7.0 CONCLUSIONS

The following table summarizes the preceding alternative economic analysis and provides a visual aid to discuss the conclusions to date and act as a background for narrowing the scope of the remaining milestone activities.

SUMMARY TABLE
ANNUAL ENERGY COST

				Mill Waste	
Strategy	Oil	Coal	Forest Residue	Forest Residue	Mill Waste
A:Dryer Only	$ 362,336 (Base 1.0)	$ 364,401 (0.98)	$ 973,833 (2.6)	---	---
B:Total Mine	$1,578,896 (Base 1.0)	$4,012,904 (2.5)	$4,012,904 (2.5)	---	---
C:Dryer Only	---	---	$ 958,292 (2.6)	$ 504,692 (1.4)	$ 468,692 (1.3)
D:Total Mine	---	---	$4,103,662 (2.6)	$2,340,847 (1.5)	$2,029,762 (1.3)

The preliminary economic results indicate that a wood fuel supply system can be a competitive economic energy option in competition with coal and oil. The key conclusions are that the wood fuel supply system will use some combination of the lower cost mill waste trucked in from near-by sawmills backed-up by a forest residue and a logging residue system.

The next major economic conclusion is that the total mine energy supply system is the best option for wood supply system. The local energy supply resources combined with a stable pricing structure based on manufacturing costs as compared to the value pricing structure of oil and coal provide the basis for a lower long-term mine energy cost structure. This basic difference in pricing structure is illustrated in the following graphic:

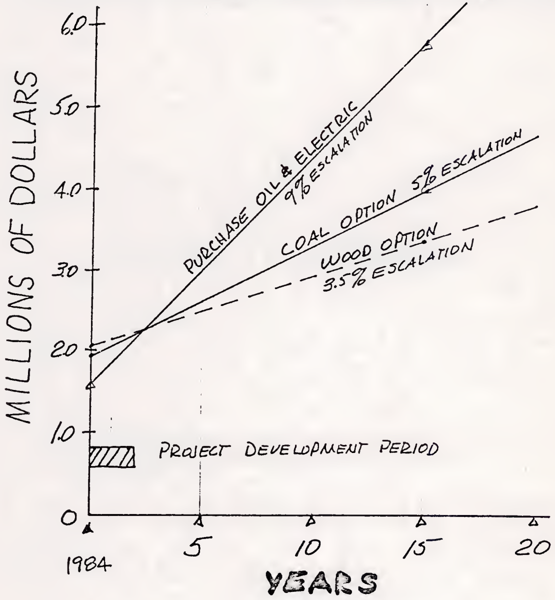
ALTERNATIVE ENERGY SOURCE
COST/PRICE STRUCTURE

OIL	COAL	WOOD
100% Market Price Structure	50% Market Price Structure	40% Capital
	50% Transportation Cost	30% Labor and Operations
		30% Transportation
World Market Product	Import Product	Local Manufactured Product

Historically, the forest products industry escalation rate is two percentage points lower than the more urban based industries. The Libby area is traditionally a strong independent labor based area with forest products as its major industry.

The following presents a preliminary economic projection of the long-term cost performance of the three energy supply systems. A detailed economic projection will be prepared in the next milestone activity.

ANNUAL MINE ENERGY BUDGET
ENERGY OPTION COMPARISON



LIST OF REFERENCES

- Michael D. Ray, P.E., Plant Engineer, W.R. Grace & Co.
- Clayton Rayson, Rayson Brothers Logging Co.
- Sam Van Arsdale, Rayson Brothers Logging Co.
- Tom Peck, CPA, Libby, Montana
- Ned Dye, P.E. Omicron Engineers and Consultants
- David G. Van Hersett, P.E., Resource Development Associates

TASK 114: PHASE I MANAGEMENT REVIEW

1. INTRODUCTION

The scope of this project is to investigate, design and document the feasibility of using forest residues in the vicinity of Libby, Montana to replace oil and coal as a long-term, dependable energy supply for the vermiculite drying operation at the W.R. Grace & Company vermiculite mine. This effort researches and documents basic information, including but not limited to a site specific data base of wood resources, recovery and combustion technology data, environmental and economic constraints, administrative requirements and the development of specific guidelines for facility sizing for the proposed bioenergy supply and conversion facilities. Conceptual engineering designs and cost estimates for all required bioenergy facilities were prepared. A comparison of bioenergy, wood and oil facilities and economic performance was prepared. This Phase I data will be used to establish the specific direction for Phase II (Milestones 3, 4 and 5). The objective of Phase II is to demonstrate that the proposed bioenergy fuel is a viable, cost-effective substitute for coal and oil at the W.R. Grace mine.

2. PURPOSE AND TASK DESCRIPTION

The purpose of this task is to prepare a Phase I management review report. This task will summarize the work completed in Tasks 100 through 113. Preliminary recommendations are to be developed and reviewed with the participants and then a formal presentation made to W.R. Grace & Co. Based on the input received from this management review process, the next phase of work will be revised per guidelines established. This task will be in two steps. First, a go/no-go decision to proceed, then establish the specific energy facility size for Phase II of the bioenergy project development analysis.

3. SUMMARY OF TASKS 100 TO 113

The vermiculite mine is located in the geographic center of the Kootenai National Forest. In cooperation with the U.S. Forest Service staff, the following annual quantities of forest residues available were indentified: 1,594,000 tons per year of logging residue and 244,000 tons per year of timber stand conversion residue. This included allowances for all private and public stands within the boundaries of the Kootenai National Forest. The total annual bioenergy reserve is 1,838,000 tons per year.

TASK 101: 15-YEAR FOREST RESIDUE RECOVERY PLAN

The objective here was to develop a 15-year plan to recover the lowest cost stagnated lodgepole pine stands with an existing road system. This resulted in identifying 2,332 acres, or 93,000 tons of potential fuel that could be easily recovered over the 15-year period. An additional 300,000 tons would be available at the next higher cost increment. The conclusion is that there is a limited supply of stagnated lodgepole pine stands. Therefore, these resources should be used as a back-up reserve to another bioenergy resource base such as logging residue.

TASK 102: RESIDUE RIGHTS

At present, the U.S. Forest Service is paying contractors to fell or pile a portion of the stagnated lodgepole pine stands annually. Given that no market of any kind exists or is foreseen for these stagnated stands, contracts would be available from the U.S. Forest Service. Additionally, rights to residue from stagnant stands or private lands in the area can be obtained from individual owners. Logging residue rights would be obtained through the purchase of timber rights. In the case of the U.S. Forest Service, the assignment of residue rights to a third party would require approval of the U.S. Forest Service.

As there is no existing market for forest and logging residues, new procedures will have to be implemented as the residue market develops. The U.S. Forest Service is very supportive of the prospective of developing a use for forest residues. The development of a procedure and strategy for securing long-term rights for residue rights will be the focus of the Phase II effort. The basic conclusion is that rights can be secured for forest residue to provide a firm and reliable back-up fuel reserve.

TASK 103: FOREST RESIDUE RECOVERY SYSTEM

The objective of this task was to develop cost/performance data for a system to recover fuel from stagnated lodgepole pine stands identified by the Kootenai National Forest staff. A thorough field investigation of three residue recovery operations in the Pacific Northwest provided the experienced data base for the preparation of residue cost/performance projections. The fuel supply system performance criterion was to have the capability to maintain the fuel supply as a single fuel supply source for the mine with no alternate fuel supply such as oil or coal. The forest residue system, operating 7 months per year, consists of feller-bunchers and grapple skidders feeding an in-woods portable chipper. Standard chip vans will be used to haul the fuel to a long-term fuel storage pile at the mine. As needed by the mining operations, fuel will be loaded into smaller trucks and hauled to the mountain top day storage fuel silo. All the forest recovery equipment to be used is common to the forest products industry and supported by strong local dealers. The forest residue system cost/performance breaks down into two logical production levels:

	Dryer Fuel	Optimum Equipment Performance
Annual Tonnage	12,000 TPY	72,000 TPY
In-woods Residue Recovery Cost (Task 106)	$50.80/ton	$30/ton

The principal conclusion is that significant reductions in the unit price for forest residue occur as the quantity requirements increase. The entire bioenergy fuel supply system is a self-supporting enterprise utilizing a local resource base of forest residues.

TASK 104: MINE ENERGY REQUIREMENTS

The mining operation can be characterized as a steady state material processing facility. The energy profile is a steady load and an ideal candidate for a wood fueled energy system. The mining operation energy requirements can be broken down into the following major categories:

Fuel Type	Annual Usage
Electric	34,000,000 KwH (6,000 Kw Demand)
Steam Fuel	350,000 gallons
Dryer Fuel	570,000 gallons

TASK 105: BIOENERGY CONVERSION FACILITY CONCEPTUAL DESIGN

The mountain top bioenergy conversion facility uses conventional industrial fuel handling and combustion equipment. The fuel will be trucked to the mountain top fuel storage silo. The silo will accommodate both wood and coal fuels. As required by the fluid bed combustor, fuel will be metered on demand. The energy conversion facility will have suitable protection for the cold winter season.

TASK 106: BIOENERGY SUPPLY SYSTEM PRELIMINARY ECONOMICS

The field investigations indicated that the lowest unit cost would be a forest residue recovery system that kept the mobil chipper busy at all times. Thus, two recovery system performance levels were evaluated, one to supply only dryer fuel and one to optimize residue recovery equipment performance.

The economic performance characteristics for these two systems are as follows:

	Dryer Fuel	Optimum Equipment Performance
Annual Fuel Production	12,000 TPY	72,000 TPY
Capital Requirement	$269,200	$828,800
Labor	6 men	22 men

Unit Cost F.O.B. Fuel Storage Yard	$50.80/ton	$30.00/ton

TASK 107: COAL SUPPLY SYSTEM

Coal would be trucked 120 miles from the Crows Nest Mine located in Fernie, B.C. The mine produces in excess of one million tons of metallurgical coal per year. The thermal coal is a by-product of the higher value coal and is piled at the mine. Standard tractor trailer units will transport the coal from the Canadian mine to the mountain top fuel storage silo at the vermiculite mine. The coal has a heating value of 8,400 Btu's per pound.

TASK 108: COAL BURNING FACILITIES CONCEPTUAL DESIGN

The coal handling and burning facilities are the same as for the wood burning system. This is to have the capability to burn either wood or coal fuels. Minor changes in the system configuration will be required when switching from one fuel to the other. This is required because of the differences in material weights and material handling characteristics.

TASK 109: PRELIMINARY COAL SUPPLY SYSTEM ECONOMICS

Coal can be purchased for $8.00 per ton F.O.B. Fernie, B.C. plus transportation costs estimated at $15.60 per ton for a total delivered price of $23.60 per ton. The transportation costs will increase over the years, along with industry transportation costs. The $8.00/ton commodity cost can be expected to be volatile over the years. In the long run, the commodity price is expected to include the following components: Administrative costs, coal handling and loading plus a profit component. These costs are estimated to be a minimum of $5 per ton. This would make the minimum long-term coal price $23.60 per ton.

The following table summarizes the annual coal quantities for various mine energy uses:

	Coal	Wood
Dryer Fuel	5,303 tons	13,706 tons
Steam Fuel	2,929 tons	7,571 tons
Electric	24,286 tons	52,889 tons
TOTAL	32,518 tons	74,166 tons

TASK 110: OIL SUPPLY SYSTEM AND ECONOMICS

The vermiculite mine purchases its oil from regional fuel oil wholesalers on a competitive bid basis. Bids are secured as dictated by the changes in the fuel oil market prices. In addition, propane burning capability was added to the mine to improve price competition for fuel oil and as a hedge to the unstable oil market. The installation of propane burning capability resulted in a significant cost reduction in fuel oil purchases. The current fuel oil supplier is Tri-State Oil Company located in Spokane.

Fuel oil is delivered by tanker truck to the W.R. Grace mine fuel oil storage tanks. Transportation costs are included in the purchase price. W.R. Grace modified their fuel oil burners to burn the lower cost #5 fuel oil in the last five years.

The current oil purchase price for the mine is $0.664 per gallon.

TASK 111: ENVIRONMENTAL ASSESSMENT

Both of the alternative energy resource options under consideration can be utilized at the mine. No significant impacts were identified that would preclude the project from being developed.

TASK 112: INSTITUTIONAL INTERFACES

A well established regulatory and licensing system is adminstered by the State of Montana. Contacts with the key agencies indicate that the licensing and permitting process is normally accomplished in a three- to six-month period.

TASK 113: PRELIMINARY COMPARATIVE ECONOMIC PERFORMANCE

The preliminary economics indicate that a forest residue based fuel cannot be competitive with Canadian coal. However, a combination of traditional sawmill waste wood trucked in from sawmills in a 70 mile radius of Libby, Montana backed up with forest residue reserves is competitive with coal. As the quantity of annual wood supply is increased, wood becomes more competitive. The more stable, locally produced bioenergy fuel supply system will be the lowest cost energy system for the mine in the long term. Both oil and coal are subject to foreign influences, and the price is value priced rather than based on a manufacturing pricing cost structure.

15-YEAR ENERGY COST PROJECTIONS

		1984 Cost	Escalation Rate	Cost at Year 15
Dryer Only	Oil	$ 372,336	5.0%	$ 774,459
	Coal	364,401	5.0%	757,954
	Wood	468,692	3.5%	787,403
Total Mine	Oil/Electric	1,578,896	9.0%	5,747,181
	Coal	1,914,948	5.0%	3,983,092
	Wood	2,029,762	3.5%	3,410,000

CONCLUSIONS

The proposed bioenergy fuel supply system is a reliable, cost effective substitue for oil and coal at the W.R. Grace vermiculite mine. The stability of the locally produced energy source yeilds lower energy costs over the more volatile coal and oil fuels in the long term.

To be competitive, the bioenergy fuel supply system must utilize a combination of lower cost mill waste fuels and higher cost forest residue fuels.

The reserves of readily available stagnated lodgepole pines are sufficient to act as a firm back-up for other bioenergy fuel supplies.

The economic competitive position of bioenergy fuels increases as the annual quantity amounts increase.

The W.R. Grace mine will consider bioenergy fuels for the total mine energy requirements as well as dryer fuel only. The annual wood tonnage for the total mine is 74,166 tons per year and 13,706 tons per year for the dryer only.

The optimum forest residue equipment performance rate is 72,000 tons per year.

The annual bioenergy fuel requirements can be easily met from the existing forest products industry in a 70-mile radius of Libby, Montana.

RECOMMENDATIONS

Proceed to Phase II (Milestones #3, 4 & 5) with the following specific directions:

Bioenergy Fuel Supply System Configuration

Primary Fuel Supply - Sawmill waste wood hauled in from sawmills outside the Libby area. (100,000 TPY average in a 70-mile radius).

Back-up Fuel Supply - Forest residue recovery from existing local area logging operations. (1,500,000 TPY potential)

Firm Reserves - Contracts with the U.S. Forest Service and private stand owners to secure residue recovery rights for a period up to 20 years. (300,000 tons available). Develop drafts of contracts and agreements to secure necessary residue recovery rights.

Prepare Bioenergy Fuel Supply System Economics

Coal Supply System - Proceed with the coal supply system as defined in Phase I.

Energy Conversion Facility Design - Use the conceptual design as proposed to prepare the preliminary engineering designs and budget cost estimates.

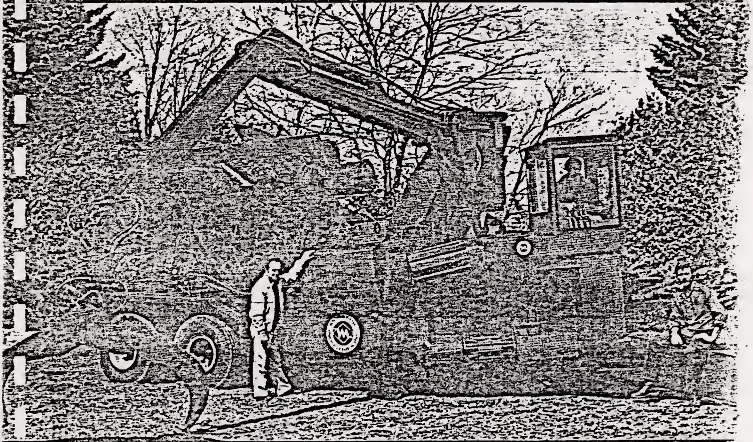
Mine Energy Requirements - Prepare two levels of energy supply for the mine, dryer only and total mine energy requirements.

Institutional Interface - Follow-up with initial institutional contacts and complete the preparation of all license and permit applications.

The Morbark Flyer

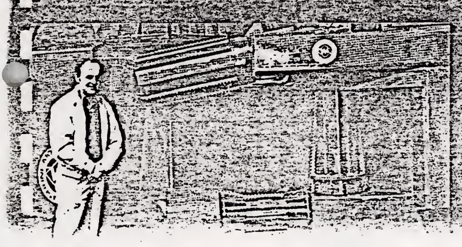
Volume No. 2

May/1983



FEATURING

THE ALL NEW MODEL 30 TOTAL CHIPARVESTOR



ALSO IN THIS ISSUE

"EXPO 83"

THE ECONOMICS OF ENERG

IDAHO HIGHBALLERS

MOR-BELL HI-TRAC

PARTS DISCOUNTS & SAVIN

USED EQUIPMENT

WHAT'S NEW AT MORBARK?

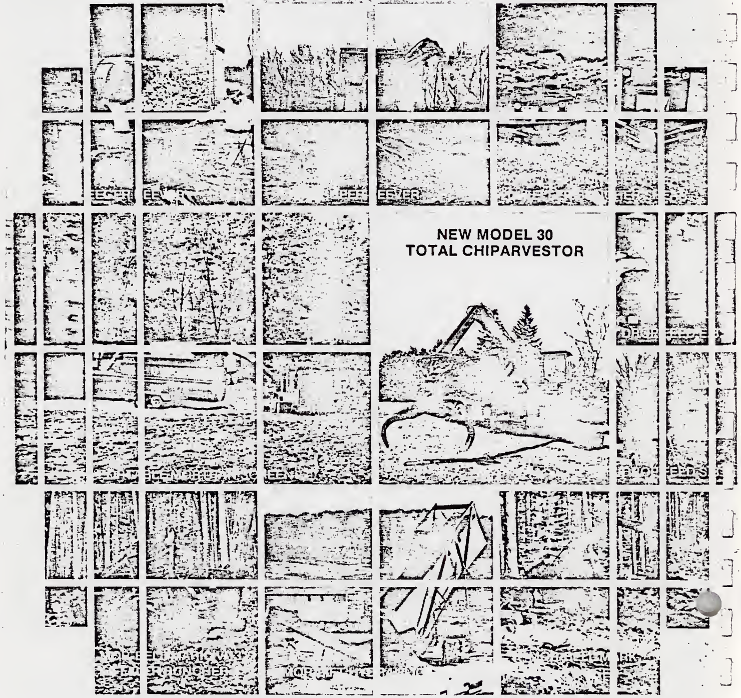
EXPO "83"

DON'T MISS OUR EXHIBIT

FEATURING:

The Unveiling of the Completely New Model 30 Total Chiparvestor

- Portable Mortran Screen
- Mor-Lift Hydraulic Dump
- Super Beever
- Eeger Beever
- Mor-Bell Mark IV 13" Feller Buncher
- Mor-Bell Mark IV Logger
- 15" Feller Buncher Shear
- 20" Feller Buncher Shear
- Drop Feed Eeger Beever
- Drop Feed Super Beever



May 20-22, 1983
SOUTHERN FOREST PRODUCTS ASSOCIATION
We'll be there and hope you will too

We extend this invitation to visit us at "EXPO 83" in New Orleans at the superdome booth #936. This year promises to be exciting with new equipment and concepts along with show discounts. See our equipment in action on a 5' screen. Let us explain to you about some of the new technologies available to the Forest Products Industry. We're sure you will agre that visiting us at "EXPO 83" will be well worth your time and effort. We look forward to talking with you about your equipment and parts requirements. Se you there on May 20, 21, and 22, 1983 .

EQUIPMENT ON DISPLAY

Model 30 Total Chiparvestor

This completely redesigned and reengineered portable chipper will be presented for the first time at "EXPO 83". See pages 4 and 5 for details.

SUPER BEEVER

A low priced whole tree chipper with multiple stem capabilities. An economical answer to pine plantation and small hardwood thinnings, the Super Beever was developed for the producer requiring a low capital investment producing up to 150 tons per day. Using many of the features built into the new Model 30 Total Chiparvestor, the Super Beever is available for under $43,000.

Portable Mortran Screen

This in-woods screening device is the key to converting whole tree chips to clean field chips acceptable for use by the pulp and paper industry. Because using this system is less costly than debarking and chipping roundwood and is extremely effective in removing overs, bark and fines while producing quality uniform chips, paper mills who previosly would not use whole tree chips are now relying 100% on clean field chips produced with the Mortran Screen. This system yields the same quality chips as using stemwood and at the same time provides fuel for the industry's boilers.

Mor-Lift Hydraulic Dump

This uncomplicated unloading system dramatically reduces material handling costs. The Mor-Lift is a unique dumping unit that features low capital investment (under $25,000), quick installation time (1 or 2 days), reduced installation and maintenance costs and quick cycle time. Available with optional built in scales, the Mor-Lift allows material unloading capabilities for practically all users for many varied applications.

Mor-Bell Hi-Trac

This unique machine will open up many new areas in mechanized logging. This unit will be presented to the public at "EXPO 83" and will prove to be one of the industry's most exciting developments. This unit features a Hi-Speed Accumulating Feller Buncher Head that operates with a cycle time 50% faster than a standard shear. It will accumulate 50% more stems allowing the machine to cut and bunch more than 400 stems an hour. See page 11 for further details.

"EXPO 83"
May 20-22, 1983
New Orleans, Louisiana

EQUIPMENT ON DISPLAY

Waste-Wood Drop Feed Chippers

These units, available in two sizes to accommodate up to 12" and 18" material, have been designed to utilize waste from sawmills, cut-up plants and tree length slashing operations such as a bundle bucker yard. Available as stationary (with diesel or electric power) or portable chippers, these inexpensive waste-wood machines are priced right to make it economically feasible to utilize these wastes.

Mor-Bell Logger

This highly versatile logging tool is capable of handling many of the odd jobs required in logging operations. Whether it is around the woodyard, on a landing or in the woods, the Mor-Bell Logger can work quickly and productively providing cost savings that make it a highly profitable investment. Come visit our booth at "EXPO 83" and watch our video presentation that will show the full capabilities of the Mor-Bell Logger.

Eeger Beever

This is the most popular tree disposal chipper on the market, known for its low operating costs, low fuel consumption and safe quiet operation. Available in many styles and with many options, we will be displaying a rear feed Eeger Beever equipped with a 63 HP Ford Model gasoline engine. Sold and serviced through a growing dealer network, the Eeger Beever is manufactured with a simple, compact design offering unsurpassed production capabilities and many economic advantages.

15" and 20" Feller Buncher Shears

These proven, dependable shears have now been further improved to provide greater quality and strength. Morbark Feller Buncher Shears feature gathering arms and accumulating fingers to quickly gather and cut several small diameter stems. These units are designed to attach close to the carrier increasing stability for shearing and carrying tall trees. Morbark shears can be mounted easily on most any woods carrier.

A video presentation will be made of the rest of the products contained in Morbark's line of equipment with a special emphasis on our line of sawmill equipment including the Mor-Pac Circular Sawmill, our line of edgers and gang edgers.

MORBARK PARTS

Morbark would like to invite you to stop by our Booth #936 during EXPO 83. Representatives from our Parts department will be available to answer questions and to assist in putting together your Parts orders. All Parts orders placed at the show will be eligible for additional discounts off our already discounted Wholesale prices.

As an added incentive and to help our customers save money during the EXPO show, we will increase our normal volume discounts by 5%

EXPO 83 VOLUME DISCOUNT STRUCTURE

Volume Amount of Each Order				Normal Discount		EXPO Discount
$ .00	-	$1,999.99	=	-0-	-	5%
2,000.00	-	3,499.99	=	5%	-	10%
3,500.00	-	4,999.99	=	7%	-	12%
5,000.00	-	and over	=	10%	-	15%

To show our appreciation to those customers who place their parts orders at the show, we will enter their names into a drawing box. Then, on Sunday at 1:00 p.m. we will hold a drawing where 10 names will be drawn with each receiving a personalized Morbark jacket. Each of the 10 names drawn will then be entered into the Grand Prize Drawing box where three names will be drawn. Third Place Winner will receive a $300.00 Parts Credit; Second Place Winner will receive a $500.00 Parts Credit; and First Place Winner will receive a $1,000.00 Parts Credit. All of which will be applied to their Morbark Parts Account.

We hope you can join us at EXPO 83 and we look forward to meeting with you.

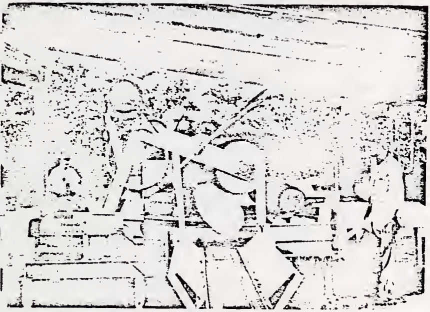
The Morbark Flyer

Volume No. 2 May/1983

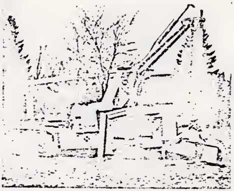
25 YEARS OF APPRECIATION

We at Morbark Industries are proud of our 25 year association with the Forest Products Industry. Beginning with the first portable pulpwood debarker right up to todays full range of products, we have attempted to recognize the needs of the industry and are always searching to find better, faster and more economical solutions to the problems of our customers. Of course, we recognize the important role that those customers have played in building our reputation and success through their trust, confidence and sometimes their patience. Often their moral support and understanding has been just as important to us as their financial backing. We realize that this partnership and cooperation has allowed us to grow right along with the industry itself, and we look forward to continuing in the development of concepts, systems and equipment to cut the cost of harvesting wood by as much as 25 to 50%. We appreciate the opportunity to work with the industry by placing equipment in the hands of loggers and sawmill operators to help further refine equipment features and operation. We know that through on site application testing we will meet our goal of achieving higher production volumes for less capital and maintenance costs. Once again, Morbark Industries would like to thank all of you for your part over the last 25 years in making our involvement in the Forest Products Industry a successful one.

In upcoming issues of the Morbark Flyer we will take a reflective look at the past 25 years of product development.



THE FIRST LOG DEBARKER PRODUCED-EXHIBITED AT SOUTHERN FOREST PRODUCTS ASSOCIATION 1959. SOLD TO GORDON & CHARLEY LOVE—NORTH CAROLINA.



The cover photo shows our newest whole tree chipper, the Model 30 Total Chiparvestor. This machine utilizes several new design features that will certainly make the industry stand up and take notice. (See page 4 for story).

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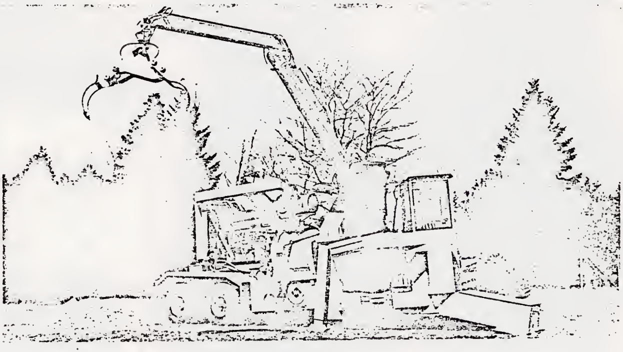
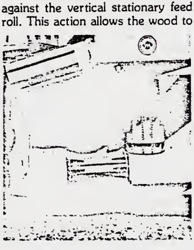
INTRODUCING THE NEW
"MODEL 30 TOTAL CHIPARVESTOR"



With the Model 22RXL as the most productive and efficient portable chipper on the market, with many years of service and dependability still to come, why has Morbark designed the new Model 30 Total Chiparvestor?

The Model 22 was fabricated using a conventional waste wood chipper designed for slabs and edgings, with a spout opening that was too small to handle large trees with limbs intact. In addition, the traditional method of conveying logs into the chipper was used, as well as using a Knuckle Boom Loader, commonly used on log trucks to lift and stack material. Now the Morbark Model 30 has made these older applications outdated in a totally re-engineered machine designed specifically for the job of chipping whole trees.

Perhaps the most important development incorporated into the Model 30 is its feed system. This newly designed feed works, a three-rolled triangular device provides 40% more torque than the Model 22. The Model 22 uses a trac chain conveyor bed and a top feed roll that applies downward pressure on the log which creates friction on the infeed conveyor making it ineffective. The Model 30 has eliminated this friction possibility by replacing the conveyor chain with a bottom feed roll. Each of the three wheels are powered separately using hydraulic gear reduction motors rather than with sprockets or chains and are designed to apply pressure from all sides of the log holding it against the vertical stationary feed roll. This action allows the wood to be kept at a constant 37½° angle to the chipper anvil providing uniform, high quality chips required by the pulp and paper markets.



The large, funnel-like spout design tapers down to a 30" x 55" opening at the chipper, allowing whole trees up to 30" in diameter or trees with large limbs to be chipped directly without the need to be delimbed using a chain saw. Because there is no friction past the feed wheels, the material is quickly and efficiently fed into the chipper.

One of the greatest problems encountered on portable chippers has been the loader. Although many types of Knuckle Booms have been tried, they either did not stand up or were not suited for the application. The Model 30 has a rugged back-hoe type loader that is virtually maintenance free. This unit has been built with great strength where it was needed and has double the pulling power and substantially greater lifting power than the loader on the Model 22. With extended reach and swing capabil-

ities, this unit can also lift up to 16 feet in the air and is ideal for reaching out, lifting and pulling material into the feed works. Because the loader does not have to lift the heal of the log onto a conveyor bed or truck, but rather just drag the log into the feedworks, this back-hoe loader is the proper type for this application.

The heavy duty chipper is designed specifically for a whole tree operation. Using a 1" belly band, which should never have to be replaced, the chipper will provide almost unlimited use without costly maintenance down time. The Model 30 has a much simpler separator device that will allow the routing of separated material either into the van or on the ground in a 10 minute, in-field conversion.

The Model 30 Total Chiparvestor is equipped with a stationary cab that is located in a safer position for the operator and provides better vision of the operation than the Model 22. All controls, guages and clutches are positioned in the cab making operation easy and efficient. With only three steps up into the cab, all functions are easily accessible.

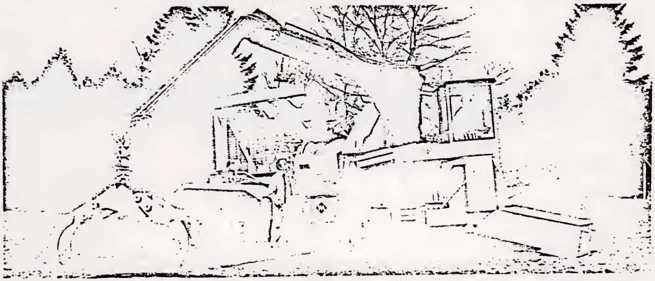
With a 700 gallon fuel tank, compared to 150 gallons on the Model 22, the Model 30 can usually run for over a week without refueling.

The Model 30 was designed to run with practically any engine, regardless of height or width. Although it is recommended that 400-800 HP be provided, there is no need to retrofit engines as all pumps run off stationary jackshafts. This design means that there is no side load on the clutch or the chipper bearing. This should eliminate all expensive (approximately $10,000-$15,000) clutch replacement costs.

There are many other improvements incorporated into the Model 30 specifically designed to make maintenance and service easier and less costly. Among these are the elimination of electrical control valves which tend to cause trouble in cold weather and a 50% reduction of hydraulic hose couplings and hoses from those used on the Model 22. All components are easily accessible for service or replacement but are engineered to provide double the machine life of previous portable chippers. During operation, the weight of the machine is carried on its base and axle rather than its hydraulic stabilizers. This provides greater stability and less vibration. The stabilizers are used primarily to lift the load for fitting to the tractor for hauling. There is also a greater ground clearance when hauling into the woods. This is important when locating the chipper onto rough terrain. With the greater availability provided by this maintenance free unit, the Model 30 will cut the maintenance cost per ton of chips by up to one half.

The Model 30 Total Chiparvestor conforms to all height, weight and width requirements to be legal size in any state for hauling, eliminating time-consuming paperwork and delays when transporting from one job to the next.

The Model 30 is the rugged, efficient answer to large diameter whole tree chipping applications and signals the beginning of a new generation of equipment to provide high quality clean field chips to the industry.



UPCOMING SHOWS & DEMONSTRATIONS

Looking at equipment in operation is the best way to determine what it will do for you. That is why we have set up demonstration facilities at our plant in Winn, Michigan to demonstrate nearly all the products that we manufacture.

We operate a whole tree chipping operation in which we can demo the Mor-Bell Feller Buncher, Mor-Bell Logger, Mor-Bell with felling saw, Morbark Eeger Beever, Morbark Super Beever, the Model 20 Total Chiparvestor, Model 22RXL Total Chiparvestor, Model 27 Total Chiparvestor and the Mortran Portable Screen.

We have both pine and hardwood forests available and can demonstrate in thinning applications. In addition to the portable equipment we have a stationary, tree length chip plant with sawmill called the Satellite Sauchip System which features the following equipment:

1. *Mor-Trac Log Sorter*
2. *72" Circular Saw Slasher*
3. *Morbark 640 Log Debarker*
4. *Mor-Pac Sawmill*
5. *Stationary Chippers*
6. *Stac-Trac Lumber Sorter*

At the sawmill facility we also have a Mor-Lift Hydraulic Dump in operation. When visiting our plant, in addition to seeing the equipment work, we invite you to see how it is built and to meet the Morbark sales, service, manufacturing and parts people that you may be working with.

If a trip to Winn is not possible, we hope that you can attend one of our local area demonstrations. Morbark will be conducting a number of field demonstrations throughout the spring and summer featuring a variety of products especially the newer machines.

COME SEE US AT THESE UPCOMING EQUIPMENT SHOWS AND CONVENTIONS

Date	Convention/Show	Location
May 4—6	Composting and Waste Recycling Conference	Columbus, Ohio
May 20—22	Expo 83 Lot #936	Superdome New Orleans, Louisiana
Sept. 8-10	Lake States Logging Congress	Duluth, Minnesota

CALL US AT 1-800-621-3540 FOR DETAILS AND DIRECTIONS TO THE DEMONSTRATIONS

We will publish a tentative schedule for all field demonstrations along with any special demonstrations and/or seminars that we will be holding here in Winn, Michigan.

THE FOLLOWING DEMONSTRATIONS HAVE BEEN TENTATIVELY PLANNED

Equipment	Demonstration Date	General Area
1. Model 30 Total Chiparvestor	First two weeks in June	Louisiana Arkansas Mississippi
2. Mor-Bell Feller Buncher with HI-SPEED accumulating feller buncher head	June	Louisiana Mississippi Arkansas Alabama Texas
3. Mor-Bell Feller Buncher with standard feller buncher head and the new HI-SPEED feller buncher head	First week in June	Central and Western Ontario
4. Mor-Bell Feller Buncher with standard head	Second week in May	Minnesota
5. Portable Mortran Screen	First three weeks in May	Arkansas Louisiana Alabama
6. Mor-Bell Feller Buncher with the new HI-SPEED accumulating feller buncher head	Last two weeks in June	Eastern Ontario and Quebec
7. Mor-Bell Feller Buncher Mor-Bell Logger Super Beever (whole tree chipper)	Last week in April	Upper Peninsula of Michigan
8. Mortran Screen Mor-Bell Feller Buncher	First two weeks in May	North Carolina
9. Portable Mortran Screen	Month in May	Packaging Corporation in Filler City, MI
10. Mortran Screen	First three weeks in May	Florida
11. Mortran Screen	Last two weeks in May	Maine
12. Mortran Screen	First two weeks in June	The Maritimes
13. Mortran Screen	Second two weeks of May	Virginia
14. Mor-Bell Feller Buncher	First week of May	South Carolina
15. Mor-Bell Feller Buncher	Last two weeks of June	Idaho Montana Colorado

U.S. FOREST RESOURCE

The following has been reproduced from our 1983 Equipment and Parts Catalog, however, we felt that the subject matter is of such importance that it would warrant presenting it here.

In subsequent issues of this flyer we will be exploring in more detail some of the concepts and procedures that are being used to make more of our forest resource available to the industry. Because these programs are being carried out today, with the equipment and technology in place, it is most important that we recognize that we are wasting precious time by not acting now. We hope that by presenting this information to as many people as possible, we can reach sufficient numbers of landowners and public officials to let them know that these techniques are not just theories for the future but practical alternatives for today.

Approximately 1/3 of this nation's total land area or about 750 million acres is forested, however, the United States Forest Service data only deals with "Commercial" lands which they define as "capable of producing industrial crops of wood" for our forest products. These volume estimates do not include lesser quality trees or tops and limbs which are merely a by-product of traditional harvesting methods. This leaves a large volume that has not been accounted for. The Forest Service figures reflect the industry's growing trend toward larger and heavier equipment which can only be used in "commercial" "clear-cut" operations.

Over the last decade, hundreds of tests have been conducted, taking samples in each forested region in the United States. The tonnage data collected by independent producers included the entire weight of the whole tree with the exception of the root system. These tests have shown that we have over 100 billion tons of forest inventory in the continental United States alone, all of which is "commercial" when energy potential is considered. That is over 450 tons of wood fiber which is equivalent to 22,500 gallons of fuel oil for every man, woman and child in the country. In addition, this vast resource increases in volume by 5% or five billion tons each year through regrowth. This does not include the accelerated reforestation processes used throughout the nation, such as the sowing of seeds, and the planting of seedlings. There is also much research growing hybrid species of trees that is proving very successful.

When this five-billion-ton increase in forest mass is compared to the 400 million tons removed for all forest products, including lumber, paper and current energy usage, it still leaves 21 net tons increase each year for every single person. Converting the energy potential of those 21 net tons, this equates to over 1,000 gallons of fuel oil.

However, the most important aspect of this vast potential, is that this fiber is by and large going to waste. Over 50% of the forest inventory consists of overmature, dead and junk wood that has no real economic value, except if converted into energy. There are thousands of acres that are standing idle, wasting away and generating no real benefit to the landowner or the nation. By utilizing proper forest management practices, such as the environmental thinning program, we have more than enough regrowth to supply our energy needs without depleting our forest resource, and at the same time we will be improving its quality and overall appearance.

There has been a great deal of study analyzing the wood resources of the state of Michigan, although it ranks only about sixteenth nationally in its total inventory. With 20 million acres representing two billion tons of wood fiber, it is estimated that as much as 50% or one billion tons is junk wood that needs to be removed as a source of energy. Utilizing proper forest management, with thinning procedures, and natural regrowth, a conservative 100 million tons can be removed annually on a sustained basis. These 100 million tons are equivalent to 150 million barrels of oil available annually. With a selling price of $35 a barrel, Michigan has the potential of generating the energy equivalent of 5 1/4 billion dollars worth of crude oil each and every year. That is over $570 for every one of the nearly 9.2 million people in the state, or enough to cover an area 20 1/2 square miles with $1 bills. This would equate to the area covered by 12,700 football fields.

If the forest potential of the state of Michigan was tapped, nearly every county could easily support a 10-20 megawatt plant to provide steam heat and electricity. The energy provided would be far less costly than that generated by imported crude oil or large nuclear facilities. There would be thousands of jobs created in building, supplying, maintaining and administering these local power units. In addition, the local economies would be greatly strengthened by having those workers circulate dollars for needed goods and services.

If we now project these same sort of tonnage figures to the entire continental United States, and its 100 billion tons of forest inventory, we realize that we truly have a vast source of energy potential greatly increasing our domestic energy reserves. The big difference between this forest "pool" of reserves and crude oil is that the forest mass increases every year by the equivalent of 7 1/2 billion barrels, instead of being depleted like oil.

Because nearly 60% of our forest resource is privately held by over five million individual landowners, it is important that we get the economic message out to the public as well as the forest industry and our elected officials. Those landowners must become aware that the environmental thinning program will increase their land value as well as improve the quantity and future value of the remaining timber.

Finally, we can best focus on the potential of our forest resource by comparing to the agricultural sector of the United States economy. There have been two main reasons for the success of this thriving industry: great technological advances, allowing American farmers to get the greatest possible production from their lands, and the free enterprise system, allowing that small individual businessman to manage and run his operation to suit his particular needs.

With the economic incentives available, the small logger, like the farmer, will utilize the market system to make the United States the world leader in wood harvesting. By harvesting for our energy needs, and also to supply a large demand for pulp and paper overseas, the independent businessman has the potential to create a nationwide industry as dynamic and economically productive as agriculture.

With private research continuing on wood gasification and other industrial applications...with the ever-continuing improvements in our wood availability through sound forest management such as environmental thinning...with the economic benefits to be felt by landowners, the wood harvesting sector and industry in general, wood energy is a practical alternative for this nation's energy needs.

"IDAHO HIGHBALLERS"

Average Better Than 75 Tons Of Chips Per Man Per Day!

It all started in 1956 when Ray Moss went to work in the woods as a utilitiy man for Diamond International. Since then, he has worked in sawmills and the woods until he struck out on his own in 1971. Ray's years of experience in a variety of jobs taught him that success only comes when you have the right equipment purchased at the right price which in turn has to be operated by conscientious, hard-working people.

Back when Ray got started into business he could not find exactly what he wanted, so he designed and built his own style "Idaho Jammer", which is still working today. When Ray decided to get into the chip business as a result of obtaining a hog fuel contract with Potlatch Corporation, he looked long and hard at the equipment available on the market and decided that for his application there was none better than a Mor-Bell Feller Buncher, a Morbark Model 20 Total Chiparvestor and a Model 40 Michigan Knife Grinder. Ray subsequently added a John Deere 640 Grapple Skidder and a Cat Model 12 Grader. Since start-up in September of 1982, Ray Moss Logging and his three-man crew have averaged over nine, 25 ton loads of chips per day and have actually reached as high as 13 loads per day!

RAY AND SUSIE MOSS

What is so remarkable about the production figures is that the trees that go into making the chips are from a pre-commercial thinning operation on the Nez-Perce Indian Reservation near Lewiston, Idaho. Ray is limited to taking only the dead, dying or unmerchantable trees under 10" in diameter. He normally removes 100-150 trees per acre leaving 200-300 trees per acre. He thins 10-15 acres per day with only one Mor-Bell Feller Buncher. Naturally he has one heck of a good operator in Jay Holzmiller who consistently averages more than 200 trees per hour felled and bunched, on slope conditions of 10%. We have faithfully promised Roy that there would be no attempts to hire his operator as a result of this article—please folks, if you buy a Mor-Bell, we will be pleased to train your operator!

JAY HOLZMILLER, MOR-BELL FELLER BUNCHER OPERATOR

PAT BAILEY, SKIDDER OPERATOR

After the trees are on the ground, Pat Bailey skids them an average distance of 600 feet to the Morbark Model 20 Total Chiparvestor. In order to maintain an average skid distance of 600', it is necessary to move the chipper from two to four times per day. The Model 20 is operated by Jerry Johnson who is Pete and Doris Johnson's son. For those of you out West, you'll know Pete and Doris because they own and operate Morbark of Idaho, Inc., which handles our sawmill line of equipment.

JERRY JOHNSON, MODEL 20 TOTAL CHIPARVESTOR OPERATOR

Now you might ask, "What does Ray Moss do while all this production is going on?" Well, Ray and his wife Susie are very actively involved. Their working day begins at 5:00 a.m. and usually ends with supper about 6:30 p.m. Ray makes the landings (2 to 4 per day), maintains the equipment, sharpens the chipper knives and otherwise insures that his operation is in top running condition.

Susie Moss keeps the books, shops for parts and supplies and is the chief cheerleader for the operation. Ray can hardly get his welcome home kiss at the end of a long hard day before Susie wants to know about the days production—team work all the way!

Now if you want to see Ray's operation or talk to him, he can be reached at his home in Clarkston, Washington in the evenings or on the weekends when he is not out fishing for the elusive steelhead. You'll find these folks super friendly and chances are you might get invited to one of Susie's famous "Potluck" suppers. (This translates as feast in our book!)

When we finished our interview with Ray, we asked him what he would change in his operation and we are pleased to quote "I wouldn't do anything different—it is the most efficient operation I've ever seen!"

THE ECONOMICS OF ENERGY

Morbark Industries is pleased to welcome Professor Lawrence W. Reed as a contributing writer to the Morbark Flyer. Professor Reed is Chairman of the Department of Economics at Northwood Institute in Midland, Michigan. He is in demand as a dynamic and effective speaker on the economy, inflation and free enterprise, and his classes have consistently drawn large numbers of students who have presented him with "Faculty Excellence" awards four years in a row, 1979, 1980, 1981 and 1982. His articles have appeared in a number of publications, and his speech "Are We Going The Way Of Rome?" has received national acclaim. He is editor and co-author, along with Dr. Dave Haywood, of a new book entitled "When We Are Free", available through Northwood Institute Press, Midland, Michigan 48640

PROFESSOR LAWRENCE W. REED

LET ALASKA SELL OIL

By Lawrence W. Reed

Few sectors of the economy are more important than energy. Because the federal government is deeply involved, the health and productivity of the American marketplace are profoundly affected by federal energy policy. Unfortunately for the consumer, Uncle Sam has blundered from one mistake to another, leaving the energy business tangled in a web of politically-inspired obstructions.

One example concerns the current debate in Congress over the Administration's proposal to lift the ban on the export of Alaskan oil. While most economists favor lifting the ban and allowing the oil to go where the market dictates, a number of congressmen are crying foul over the idea. Exporting Alaskan crude to anyone but Americans, they say, is "madness". To support their case, these protectionists-in-reverse employ emotional arguments for economic nationalism.

Looking beyond the political points to be scored by appearing as "defenders" of American oil, the pro-ban congressmen are really spouting economic nonsense. It seems that the economists' burden of explaining economics to legislators never goes away.

Because of the export ban, Alaskan oil is currently creating a glut and discouraging oil production in California. Half of the oil from the 49th State, therefore, has to be shipped to the East Coast and Gulf Coast at considerable cost to the American consumer.

Moreover, this is relatively high sulphur crude that requires special refinery equipment. Much of California's capacity was built to handle "sweet" crudes from Indonesia and other foreign sources. The Alaskan crude would work very well in Japanese refineries, and one solution would be to sell Alaskan crude to Japan and use the proceeds to buy crude more suitable to California refineries. Such a plan was pushed recently by economists for the oil industry, but it was thwarted by Congress' ban on the export of Alaskan crude. Lifting the ban would not reduce the flow of oil to the lower 48 states; it would, in fact, increase it and lower its basic cost as well.

Other benefits from exporting some Alaskan oil are waiting to come in our direction if only Congress will get out of the way:

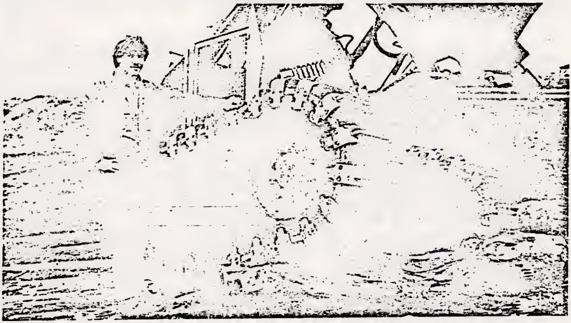
1. *Incentives to produce more oil would be enhanced. The power of the OPEC cartel would then be further weakened as more oil would flow onto the world market.*
2. *Our trade imbalance with Japan would be substantially improved, easing pressure on the American dollar.*
3. *Revenues to both the State of Alaska and the federal treasury would increase, permitting a reduction in tax rates to further spur economic growth.*
4. *Relations with our Far Eastern allies would be enhanced.*
5. *The proposed construction of a $2 billion pipeline from Puget Sound to the Midwest would be unnecessary.*
6. *The current costly and wasteful tanker traffic from Alaska to the East Coast would be greatly reduced.*

Few people will argue that the capacity of the Saudi Arabians to produce and export oil has made them a powerful force in the world marketplace. They certainly didn't get where they are by selling it to themselves. What's so bad about America competing in that marketplace also?

Blocking the export of Alaskan oil imposes great costs, ultimately borne by the U.S. taxpayers and consumers. It is a wasteful, unproductive, political intervention. It stifles our ability to compete and hurts the Alaskan economy too.

I urge readers to write and tell Congress that supply and demand will do a better job in the oil market than silly laws like this one. Tell them to repeal it!

TESTS SHOW BIG POTENTIAL FOR NEW MOR-BELL HI-TRAC



Morbark Industries is pushing ahead in its efforts to bring innovative and cost effective equipment to the American Logger.

Introduced initially to the North American market in 1980, the Mor-Bell tractor has undergone numerous design changes aimed at making it the most effective machine for all logging conditions.

The company's most recent development is the tracked version of the Feller Buncher called the Mor-Bell Hi-Trac. Recent testing of the prototype machine has shown that the Hi-Trac has achieved both of its major design goals, improved flotation and increased traction without sacrificing maneuverablity, speed or production.

While the Mor-Bell with standard tire equipment has a low ground pressure of only 8 PSI and can log areas too wet for conventional skidders, the Hi-Trac's super low ground pressure of only 3.75 PSI represents a major breakthrough in reducing ground compaction.

The Hi-Trac's excellent flotation characteristics make it an ideal machine for both low land and swamp logging. At the other end of the scale it is expected to perform equally well in deep snow conditions.

While the Hi-Trac maintains most of the renowned maneuverability of the standard machine, the extra traction permits the Hi-Trac to operate on steeper rougher terrain than was previously possible.

The tracks used are the same proven over-the-tire type adapted to other logging machines, however, the design for the track assemblies give it two distinct advantages. First, unlike a fixed track, the bogie assemblies on the Hi-Trac can pivot independently so the track always maintains full ground contact and produces a walking effect when needed to climb over obstacles like stumps and rocks without severely pitching the machine.

The second advantage offered over other track machines is a full 18 inches of ground clearance allowing the machine to ride over, rather than drag itself through deep snow or mud.

The Hi-Trac will be offered with a larger 65 horsepower 4 cylinder engine. The 30% increase in power, combined with the 25% increase in wheel torque gives the Hi-Trac the necessary muscle for the worst of conditions.

The new Morbark Hi-Speed accumulating Head was designed specifically for the Mor-Bell feller buncher and will greatly add to the Mor-Bell's productivity. Utilizing one fixed blade with an accumulating pocket and one moveable blade, the cutting cycle of the head has been increased by better than 30% over the standard head. The accumulating pocket has been increased in size increasing the accumulating capacity of the machine by 50% and the unique accumulating arms hold the trees firmly in an upright position. Production of the prototype has been timed at better than 400 stems an hour and the maximum diameter shearing capacity is now 15".

Currently, the Hi-Trac is undergoing an extremely rigid field test program with full production scheduled to begin by late summer.

While Morbark Industries has kept the Hi-Trac "underwraps" until now, we will unveil this exciting new machine public at the New Orleans Logging Exposition 83, in May. Stop by the Morbark Exhibit, see our equipment for 83 and catch a videotaped glimpse of the Logging machines of the future. We hope to see you there.

JOIN THE NATIONAL WOOD ENERGY ASSOCIATION
HELP PROMOTE WOOD AS AN INDUSTRIAL FUEL COMMODITY
SHARE IN OUR EFFORT AND SHARE IN THIS GROWING MARKET

NWEA can assist in the development of your local market and put you in touch with potential wood fuel users through our referral service and our regional wood energy seminars.

A stable, well developed market is essential to the fuel producer, the combustion equipment manufacturer and the fuel consumer. Let's join together through NWEA and make it happen.

If you are involved in the Forest Products Industry, then you should be involved in the National Wood Energy Association because:

Environmental Thinning will protect our forest resource and benefit us all by making more land available for harvest, plus increase the supply of pulp, saw and veneer wood material.

Industrial Wood Energy Consumption will provide the market for thinnings and "junk" wood which will make Environmental Thinning economically feasible.

Education is the key to bringing our plans about. Individually we cannot accomplish what we can as a group. Our industry needs to be strengthened—we need a strong voice to promote our cause.

Your Membership will denote you as a leader in this effort and will provide you with:

-National representation at trade shows and regional seminars
-Consumer handouts
-Biologue, our monthly newsletter
-Industrial Wood Energy Directory and a listing in it
-Access to information gathered by NWEA and shared by its members

JOIN NWEA

Use the attached membership card or contact Dave Keenan, Executive Director, 8400 S. Winn Rd., Route 3, Mt. Pleasant, MI 48858, (517) 866-2650

INTRODUCTORY MEMBERSHIP OFFER

Yes! I want to join the National Wood Energy Association and join the drive to educate America about our nation's greatest untapped renewable industrial resource. Keep me up to date on new equipment and technology, market trends, forest management programs and techniques, publications, seminars and news of industry successes. Please enroll my company in the category checked below:

☐ **Full Membership - $250 -** for companies involved with wood energy. Includes Biologue each month, wood energy industry directory, discounts on conventions, seminars, and sales materials, NWEA updates, the right to vote for Board members and to serve on committees and the Board.

☐ **Associate Membership - $100 -** for companies not yet involved in wood energy. Includes Biologue each month, wood industry equipment directory and access to conventions and meetings.

☐ **Special Associate Membership - $50 -** for non-profit organizations and students. Includes some benefits as Associate Membership.

Name ______________________________
Title ______________________________
Company ______________________________
Address ______________________________
City ______________ State ______________ Zip ________
Phone ______________________________

☐ Payment enclosed
☐ Bill my company

Send to:
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8400 S. Winn Rd. — Route #3
Mt. Pleasant, Michigan 48858

POWER UP
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AND GET THES
BENEFITS!

- Monthly Newsletter
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- Equipment Directory
- Industry Seminars
- Research Updates
- Studies on Successes
- Publications List
- Sales Materials

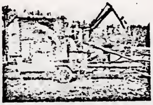
USED EQUIPMENT INVENTORY

TOTAL CHIPARVESTORS

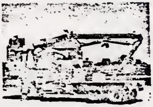
ITEM	MODEL	S/N	ENGINE	CHIPPER	LOADER	SELLING PRICE
1	22	1136	380 Cummins	3-Knife, Non-Separator	Barko 160 Knuckle Boom	$ 95,000.00
2	22	1146	12V71 GMC	3-Knife, w/separator	Prentice T-100	100,000.00
3	22	1162	380 Cummins	3-Knife, non-separator	Savage 100 Knuckle Boom	—
4	22	1350	12V71 GMC	3-Knife SOLD tor	Savage 180 w/353 Aux.	105,000.00
5	22	1358	380 Cummins	3-Knife SOLD tor	Prentice 210 w/353 Aux.	125,000.00
6	22	1372	380 Cummins	3-Knife	Slide Boom	—
7	22	1384	12V71 GMC	3-Knife	Savage 180 Knuckle Boom	115,000.00
8	22	1438	12V71 GMC	3-Knife, w/separator	SS-300 Slide Boom	—
9	48	106	471 Detroit Diesel	2-Knife	Prentice F-BC Knuckle Boom	35,000.00
10	550	079	VT-903 Cummins		Slide Boom Loader	—
11	550	081	VT-903 Cummins	2-Knife, w/separator	Slide Boom Loader	—
12	550	098	VT-903 Cummins	2-Knife, w/separator	Slide Boom Loader	90,500.00
13	Precision	C1389L-103	600 K Cummins	4-Knife	No loader	—
14	Super Beever	101	Avco	3-1/3 kr SOLD	Knuckle Boom Loader	38,000.00

NOTE: Machines without prices are in the process of being rebuilt. Prices will be established after rebuild is completed.

ITEM 9



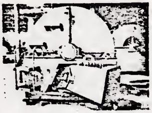
ITEM 14



MODEL 22

MODEL 550

ITEM 9



CHIPPER

CHIPPERS

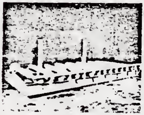
ITEM	MODEL	S/N	DESCRIPTION	SELLING PRICE
1	48"	641	3-Knife, Horizontal Feed, Top Discharge	—
2	48"		Bush, Drop Feed	—
3	75"		Experimental, Multi-Knife, disc only, non-separator, for 3/8" bedding chips	3,000.00
4	60"		Fulghum, 4-Knife, Horizontal Feed, Top Discharge	—
5	75"	128	6" Disc, 3-Knife with Discharge Spout	—
6	75"	192	Precision, 4-Knife, Horizontal Feed, End Disccharge	15,000.00
7	75"	214	2-Knife, Horizontal Feed, End Discharge	17,500.00
8	75"	588	3-Knife, Horizontal Feed, End Discharge	17,500.00
9	84"	C1064	Precision, 3-Knife, Horizontal Feed, End Discharge	18,000.00
10	75"		3-Knife, complete chipper with base and power	34,000.00

EEGER BEEVERS

ITEM	MODEL	S/N	DESCRIPTION	SELLING PRICE
1	Curb Feed	HD-022	2-Knife, 3/4" Chip, Wisconsin Engine, 3500# Suspension, Stationary Tongue Jack, Adjustable Hitch, Safety Chains, Running Lights, Swivel Discharge	$7,500.00
2	Curb Feed	HD-050	2-Knife, 7/8" Chip, Wisconsin Engine, 3500# Suspension, 3/4" Ball Hitch, Stationary Tongue Jack, Long Adjustable Hitch, Safety Chains, Running Lights, Swivel Discharge	7,500.00
3	Curb Feed	HD-073	2-Knife 3/4" Chip, Wisconsin Engine, 3500# Suspension, Pintle Ring Hitch, Stationary Tongue Jack, Safety Chains, Running Lights, Swivel Discharge	7,500.00
4	Curb Feed	EC-171	2-Knife, 3/4" Chip, Wisconsin Engine (New), 3500# Suspension, Ball Hitch, Stationary Tongue Jack, Long Adjustable Hitch, Safety Chains, Running Lights, Swivel Discharge, Tool Box	7,950.00
5	Curb Feed	E-297	2-Knife, 3/4" Chip, Wisconson Engine, Hydraulic Knuckle Boom Loader	—

EEGER BEEVER

ITEM 7 & 8



ITEM 4

ITEM 20

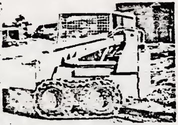
ITEM 2

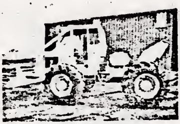
CONVEYORS

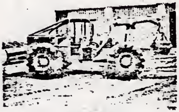
ITEM	S/N	DESCRIPTION	SELLING PRICE
1	244	632 — 20' Infeed, 8110 Chain, Hydraulic Drive with power	$ 2,400.00
2	248	632 — 20' Infeed, 6110 Chain, Hydraulic Drive with power	3,000.00
3	817	632 — 20' Infeed, Tilting, 8110 Chain, Hydraulic Drive with power	2,400.00
4	—	16' NW Infeed, With infeed kicker, Without drive	3,450.00
5	2490	20' C-Series Hourglass Roll Case, With 4-arm kicker, Without drive, 22" Rolls	3,950.00
6	2745	20' C-Series Hourglass Roll Case, No kickers, Without drive, 22" Rolls	3,650.00
7	—	100' x 24" Bark Conveyor, 6114 Chain, 10-HP reduction drive with motor and starter	5,900.00
8	—	100' x 24" Bark Conveyor, 6114 Chain, 10-HP reduction drive with motor and starter	5,900.00
9	2013	36' x 8" Waste Conveyor, 87 Chain, With rubber flites. Reduction drive with with 5-HP motor	1,700.00
10	3102	24' x 8" Waste Conveyor, 67 Chain, With rubber flites, Hydraulic Drive without power	1,000.00
11	82-3104	15' x 8" Waste Conveyor, 67 Chain, With rubber flites, Hydraulic Drive with power	1,000.00
12	2058	12' x 14" Chip Conveyor, C-188 Chain, Witl SOLD 1 flites, Hydraulic Drive without power, No legs	1,500.00
13	3054	20' x 24" Chip Conveyor, C-188 Chain, With wooden flites	3,300.00
14	3090	50' x 20" Flat Top Chip Conveyor, C-188 Chain, Without drive, No legs	4,000.00
15	3091	50' x 20" Flat Top Chip Conveyor, C-188 Chain, Without drive, No legs	4,000.00
16	3100	15' x 24" Chip Conveyor, C-188 Chain, With wooden flites, Hydraulic Drive with power, No legs	1,896.00
17	3101	20' x 48" Chip Conveyor, C-188 Chain, With wooden flites, Hydraulic Drive without power, No legs	3,500.00
18	3103	60' x 24" Flat Top Chip Conveyor, C-188 C SOLD raulic Drive with power, Top of chain approx. 60"	4,800.00
19	82-007	40' x 30" Belt Conveyor, No drive, Conveyor raises at 30 degree angle beginning 9' from idler end	5,000.00
20	2SC100	100' x 24" Belt Conveyor, Radial Stacking, Hydraulic Drive with power	24,000.00
21	52-1865	24' x 14" TTC, 6110 Chain, No drive, Height of sides from bed 13", F-stop 40" from drive end	3,400.00
22	82-3105	20' x 14" SPECIAL TTC, 6110 Chain, Hydraulic Drive without power, 3/8" x 23" high sides, No legs	3,000.00

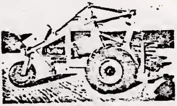
SKIDDERS

ITEM	MODEL	S/N	DESCRIPTION	SELLING PRICE
1	Timberjack	9076	Model '68 Grapple Skidder, 25.5" x 32" tires, 6 cylinder 354 Perkins diesel, hydrostatic	$10,000.00
2	Mountain Logger	74125	ML-100 Cable Skidder, 18.4" x 26" tires, 453 Detroit diesel, Clark reversing 4-speed power shift transmission, no-spin front and rear, root rake, 32,000 lbs. Gearmatic winch	42,500.00
3	Mountain	74164	New ML-100 Cable Skidder, 18.4" x 26" tires, 453 Detroit diesel, Clark reversing	
3	Mountain Logger	74164	New ML-100 Cable Skidder, 18.4" x 26" tires, 453 Detroit diesel, Clark reversing 4-speed power shift transmission, no-spin front and rear, 32,000 lbs. Gearmatic winch	47,100.00
4	Mountain Logger	74174	New ML-130 Cable Skidder, 23.1" x 26" tires, 453 Detroit diesel, Clark reversing 4-speed power shift transmission, no-spin front and rear, 32,000 lbs. Gearmatic winch	54,500.00
5	Hydro-Mac	42780	Model 20C Skid Steer Loader, diesel engine, 12.00 x 16.5 tires, tracs and buckets available	13,300.00
6	Hydro-Mac	42781	Model 20C Skid Steer Loader, diesel engine, 12.00 x 16.5 tires, tracs and buckets available	13,300.00
7	Hydro-Mac	42782	Model 20C Skid Steer Loader, diesel engine, 12.00 x 16.5 tires, tracs and buckets available	13,300.00
8	Hydro-Mac	42783	Model 20C Skid Steer Loader, diesel engine, 12.00 x 16.5 tires, tracs and buckets available	13,300.00
9	John Deere	271607	440C Cable Skidder, 70 HP, 1977	20,000.00


HYDRO-MAC


MOUNTAIN LOGGER SKIDDER


TIMBER JACK SKIDDER


MOR-BELL FELLER BUNCHER

MOR-BELL LOGGER

MOR-BELL LOGGERS

ITEM	S/N	DESCRIPTION	SELLING PRICE
1	MB-11	Mor-Bell Logger with Grapple	$33,500.00
2	MB-13	Mor-Bell Logger with Grapple	—
3	MB-17	Mor-Bell Logger with Grapple	36,500.00
4	MB-31	Mor-Bell Logger with Grapple	35,500.00
5	MB-35	Mor-Bell Logger with Grapple	—
6	MBS-40	Feller Buncher with 13" Shear	—

COMPLETE SAWMILL FOR SALE

Morbark Medium Duty Live Deck 20' Long, S/N 2044, 3-strand with 3-arm stop and loader

Morbark 636 Debarker, S/N 339, 25' trough type infeed conveyor, 25' trough type outfeed conveyor, one set of manually operated 3-arm kickers, 100-HP T-frame motor to operate the cutterhead, 30-HP T-frame motor to operate hydraulic system

Morbark Mor-Pac Mill, S/N 2998, log stop and loader, chain bar log turner, automatic carriage with 6-position push button setworks, 4" tapers on each knee, 36" opening, 40-HP 20" diameter 2-saw vertical edger with push button setworks, saw husk with 54", 42-tooth 7-8 gauge "F" style blade

Morbark Heavy Duty Green Chain, S/N 1949, 20' long, 3-strand

Morbark Heavy Duty Green Chain, S/N 1950, 50' long, 3-strand

Morbark Vibrating Conveyor, S/N 033, 20' x 21"

Morbark 586 Series "E" Chip Pac, S/N 598, with Morbark 58", 6-knife, horizontal feed chipper

Morbark Automatic One Man End Trimmer, S/N 2953

Frick 7-Saw Bull Edger size #641, S/N 241—Kat Guard Air Compressor, S/N 28729—Patz Conveyor System complete with 30' Upright Conveyor, S/N C1661811479—Extra saws for both the Bull Edger and the Sawmill—Complete wiring with all disconnects

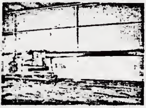
METAL BUILDING PLUS EIGHTY (80) ACRES OF LAND NEAR INTERNATIONAL FALLS, MN.

PRICE FOR THE COMPLETE MILL, LAND AND BUILDING $250,000.00

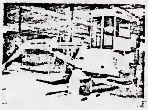
PRICE FOR THE EQUIPMENT ONLY $180,000.00

DEBARKERS, CHIP-PACS, DECKS AND SCREENS

ITEM	MODEL	S/N	DESCRIPTION	SELLING PRICE
1	632 Debarker	854	20' Infeed, 20' Tilting Outfeed, 75-HP Allis Chalmers Electric Motor, Bark Auger	$16,000.00
2	EM-16 Debarker			—
3	EM-16 Debarker			—
4	EM-18 Debarker			—
5	28" Forano		Ring Debarker, New trough type infeed, electrical panel	—
6	Mortran Screen	81-001 81-002 81-003	Stationary Screen, 3-Section, 75 ton per hour capacity	30,000.00
7	Mortran Screen	81-015	Stationary Screen, 3-Stage overs screening system, 90 tons per hour capacity	12,000.00
8	Mortran Screen	81-017	Portable Screen, Complete with surge bin	61,500.00
9	Mortran Screen	81-027	Portable Screen	75,000.00
10	Mortran Screen	82-029	Portable Screen	75,000.00
11	Mortran Screen	82-030	Portable Screen	82,000.00
12	Mortran Screen	82-032	Portable Screen	82,000.00
13	Stac-Trac	257	25-HP Onan, Gasoline Engine, 30' Track	14,000.00
14	Blower	371	10-HP, 10' blow pipe and base	—
15	58" Chip-Pac	599	"E", 6-Knife, horizo SOLD 150HP electric motor, prewired panel	—
16	48" Chip-Pac			—



SLIDE BOOM



ITEM 15

20" SHEAR

SHEARS AND LOADERS

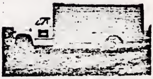
ITEM	MODEL	S/N	DESCRIPTION	SELLING PRICE
1	10"	10-5	Feller Buncher Shear	—
2	10"	10-6	Feller Buncher Shear	$ 4,000.00
3	13"	8-7	Feller Buncher Shear	—
4	15"	1413	Feller Buncher Shear	—
5	15"	1423	Mounts for 510 IHC Payloader, additional accumulating finger	9,000.00
6	20"	2197	Brackets for additional accumulating finger, 3" Pins	11,500.00
7	20"	2217	Additional accumulating finger, 2 1/2" Pins	10,000.00
8	20"	2300	Mounts for JD544C — NEW, Steel bottom plate added	14,000.00
9	20"	2322	Mounts for 227 Cat Excav., brackets only for additional accumulating finger	12,000.00
10	20"	7420301	Fulghum Directional Felling Shear, 8" x 28" main cylinder, quick tach for Melroe 1074 or 1075	2,500.00
11	3000		Used Slide Boom loader, complete for Model 22RXL Total Chiparvestor	14,000.00
12	Lucky Loader	31775535	Model L-1014MC, NEW 353 GMC Aux. power, 36" log grapple, live heel	20,000.00
13	MT Carriage	149	Heavy Duty Mor-Trac Carriage, 4-wheel hydraulic drive powered from loader	17,950.00
14	12 Loader		NEW, No grapple, No cab, No control valves	7,000.00
15	Prentice H	15315-73101	NEW cab and door, all cylinders checked out, No grapple	8,700.00
16	Mor-Lift	1009	Loader	—
17	10"		Feller Buncher Shear, ran approximately 85 hours, opened up for 15" diameter stems, 5stems, 5½" Diameter Cylinders	5,500.00
18	Hydro Ax		1980, 511 Prime Mover with 20" Morbark Feller Buncher, Screen Cab, Machine Protection Group, Sky-Light, Spark Arrestor, Defroster Fan, Rear & Front Window Guards, No Spin Differenals, 34 x 67 Tires	35,000.00

EXPERIMENTAL AND MISCELLANEOUS

ITEM	MODEL	S/N	DESCRIPTION	SELLING PRICE
1	Model 18		Total Chiparvestor, SOLD oo.n with cab, No engine	—
2	Pole Assistor		Used for debarker or pole peeler	—
3	Bark Blower		PS-8 style	—
4	Blower		36" Phelps, With 20-HP motor	500.00
5	Pump Stand		30 gallon tank, 10-HP, one-section gear pump, DF4 valve	1,500.00
6	Pump Stand Base	379	100 gallon, can mount up to 4 individual double pumps	—
7	Pump Stand Base		90 gallon, can mount 2 individual double pumps	—
8	30' Blow Pipe		For Rail Car loading, with legs and discharge (just like new)	4,000.00
9	Motor Base		Used for 3-Knife 75" stationary bottom discharge Chipper with 400-HP US electric motor and starter	34,900.00
10	Thrower	023	30-HP, can be hydraulic or electric, short power, hopper, swivel chain, motor, spout	—
11	Chip Thrower	026	Hydraulic, 10,000 Char-Lynn, conveyor mount, swivel discharge, short swivel motor, spout and tilt cylinders	—
12	Thrower	027	30-HP, Swivel discharge, short power, hopper, spout, swivel chain and motor	—
13	Chip Thrower	028	Hydraulic, 10,000 Char-Lynn, swivel base	—
14	Chip Thrower	029	48", Model 22 type transition and discharge spout	—
15	Chip Thrower	030	50", Model 22 type transition and discharge spout	—
16		F-04-38	Disc-Scalping Screen	—
17		0-11-158	Class-A-Fiber	—
18	Ford Engine		4 Cylinder with clutch, approximately 30-HP (used)	—
19	471 Detroit Diesel		With radiator, no hood or side curtains, LH, 100-HP continues 133-HP gross	—
20	6V71 Detroit Diesel		Complete unit, LH SOLD continuous 238-HP gross	—
21	353 Detroit Diesel		New, complete uni SOLD)-HP continuous 101-HP gross	—

ITEM 18

ITEM 4


ITEM 6

SATELLITE SAUCHIP SYSTEM

ITEM	MODEL	S/N	DESCRIPTION	SELLING PRICE
1	Mack Glider	78WSK700642	1978, V-8, 13-speed, non-sleeper, tandem axle Michigan special	$20,000.00
2	Mack Tractor	MICH 77732	1977, V-8, 13-speed, non-sleeper, tandem axle Michigan special	17,000.00
3	Mack Tractor	F5797LST22430	1974, V-8, 13-speed, tandem axle Michigan special	10,000.00
4	IHF2070	75797OGB23399	1974, Quad Axle, 290 Cummins with dual air axle, lift and Prentice loader	21,000.00
5	IH Tractor	259471G516309	1972, 13-speed, transmission, 335 Cummins, non-sleeper, tandem axle with hydraulic pak	5,000.00
6	Chev C-60	CE63P814934	1969, 366 V-8, 4-speed transmission, complete parts and service van	4,500.00
7	40 Knife Grinder	385	Complete with t SOLD 6 x 3 x 4-1/2 nut inserted wheel, 5 gal. coolant	4,700.00

As a service to our customers, Morbark is listing the following trucks and trailors that are offered for sale by a national truck liquidation company. For more information on any specific item, call 1-800-621-3540 and ask for Sue at Extension 226.

SINGLE AXLE — CONVENTIONAL

ITEM	QTY.	MODEL	DESCRIPTION	UNIT PRICE
1	20	Ford LN 8000	1977, CAT 225, 5X2	$9,500.00
2	15	Ford LN 7000	1977, CAT 190, 5X2	6,500.00
3	10	Ford LN 9000	1975, 290 Cum, 10 Speed	6,500.00
4	10	Ford LN 8000	1975, CAT 190, 5X2	5,000.00
5	10	IHC 2070 A	1975, 230 Cum, 5X2	5,000.00
6	25	Fords, IHC, Whites	1974/1970, 5 & 10 Speeds	3,000/4,500

CHIP VANS

ITEM	QTY.	MODEL	DESCRIPTION	UNIT PRICE
1	30		1969/1972, 40' Smooth Interior	$1,250/2,250

OPEN TOP (CHIP TRAILERS)

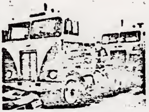
ITEM	QTY.	MODEL	DESCRIPTION	UNIT PRICE
1	80	Gindy	1974, 45' Tarps/Smooth Interior	$3,500.00

DRY FREIGHT VANS

ITEM	QTY.	MODEL	DESCRIPTION	UNIT PRICE
1	190	Freuehauf, Pine, Trailmobile	1976/1977, 45' x 13'/13'6"	$4,950/6,500
2	250	Freuhauf, Pine, Gindy	1971-1975 45' x 13'/13'6"	2,250/4,250
3	6	Fruehauf (Insulated)	1974, 42' x 13'	1,500.00

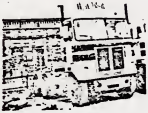
FLATS

ITEM	QTY.	MODEL	DESCRIPTION	UNIT PRICE
1	4	—	1969/1979, 40'	$2,000/5,000



TANDEM AXLE — CAB-OVER — SLEEPERS

ITEM	QTY.	MODEL	DESCRIPTION	UNIT PRICE
1	3	Peterbilt	1977, 350 Cum, 10 Speed	$17,500.00
2	6	Ford CLT 9000	1979, F 290 Cum, 9 Speed	17,250.00
3	1	Mack Cruisliner	1979, 300 Maxidine, 10 Speed	17,500.00
4	2	Kenworth	1977, 8V92T Detroit, 10 Speed	15,500.00
5	1	GMC Astro	1977, 8V92T Detroit, 9 Speed	14,500.00
6	1	Kenworth	1975, 350 Detroit, Allison	8,500.00
7	1	GMC	1978, 350 Cum, 10 Speed	15,500.00
8	3	Peterbilt	1977, 350 Cum, 10 Speed	15,500.00
9	2	Kenworth	1974, 318 Detroit, 10 Speed	7,500.00
10	1	White Freight Liner	1972, 318 Detroit, 10 Speed	6,000.00

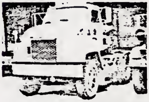


TANDEM AXLE — CAB-OVER — NON-SLEEPER

ITEM	QTY.	MODEL	DESCRIPTION	UNIT PRICE
1	5	White Freight Liners	1977, F290 Cum, 10 Speed	$ 8,000.00
2	8	White Road Commander	1977, F290 Cum, 10 Speed	7,000.00
3	8	White Freight Liner	1976, F290 Cum, 10 Speed	6,500.00
4	10	White Freight Liner	1975, 290 Cum, 10 Speed	5,500.00
5	2	White Freight Liner	1973, 290 Cum, 10 Speed	4,500.00
6	11	White Freight Liner	1972, 8U7IN Detroit, 10 Speed	4,250.00
7	6	Peterbilt	1977, 350 Cum, 10 Speed	14,500.00
8	9	Peterbilt	1976, 350 Cum, 10 Speed	13,500.00

SINGLE AXLE — CAB-OVER — NON-SLEEPER

ITEM	QTY.	MODEL	DESCRIPTION	UNIT PRICE
1	10	White Road Commander	1977, F 290 Cum, 10 Speed	$6,500.00
2	4	White Road Commander	1975, F 290 Cum, 10 Speed	Offer
3	7	White Compact 6000	1972, Cum 250, 5X2	3,500.00
4	30	Ford, IHC	1968/1972, Gas, Straight Trucks & Tractors	Offer



TANDEM AXLE — CONVENTIONAL CAB — NON-SLEEPER

ITEM	QTY.	MODEL	DESCRIPTION	UNIT PRICE
1	5	Mack U686ST	1978, 300 Maxidine, 10 Speed	$17,250.00
2	10	White Road Boss	1977, 6U92 T Detroit, 9 Speed	7,250.00
3	1	White Road Boss	1977, 290 Cum, 9 Speed	7,750.00
4	2	Hendrickson	1977, 6U9LT, 10 Speed	7,500.00
5	1	Hendrickson	1975, 290 Cum, 10 Speed	5,500.00
6	6	GMC 9500	1973, 671 Detroit, 15 Speed	5,000.00
7	10	White 9564 T	1972, 250 Cum, 10 Speed	4,500.00

These knives are all manufactured by Michigan Knife, carry guaranteed to perform specifications. They are of th exact quality, material and workmanship as our regular daily production. This list of knives are now moving item which we are offering at cost prices. Please contact Cindy Jackson or Terry Jacks, 616-796-4858 to place your orders.

MICHIGAN KNIFE CO. DISSTON-PHILBRICK PRODUCTS

F.O.B. Big Rapids, Michigan or Springfield, Oregon

First Come, First Serve!
Order while they last

Home Office
120 Pere Marquette Street
Big Rapids, Michigan 49307
(616) 796-4858

West Coast Sales
886 Shelley Street
Springfield, Oregon 97477
(503) 726-1774

QTY.	KNIFE NO.	MACHINE	SIZE	SALE PRICE
37	1-156B	78" Black Clawson Chipper	24 x 6 x 1/2	$ 52.00
41	1-183	112" Sumner Half Chipper	14-1/2 x 5 x 1/2	26.80
206	10-102	30" Morbark Half Counter	15-7/8 x 2-7/8 x 3/8	15.00
16	11-106	84" Fulghum Half Counter	13-1/4 x 3 x 3/8	14.00
16	11-107	66" Fulghum Half Counter	10-3/4 x 2-1/2 x 3/8	10.00
23	11-108	84" Fulghum Chipper	26-1/2 x 4-3/4 x 1/2	47.65
20	2-205	36" CM&E Chipper	9 x 3 x 1/4	10.45
23	2-225T	48" Norman Chipper	16 x 4-1/2 x 3/8	21.00
41	2-246R	Swecan	10-3/16 x 6-7/16 x 3/8	34.75
15	3-310	48" Bush Rechipper	15 x 3 x 1/2	17.75
12	3-312	Kockums	2 x 5-3/4 x 7/8	25.25
34	3-314LA	58" Kockums	8-7/8 x 3 x 3/4	21.50
61	3-314RA	58" Kockums	8-7/8 x 3 x 3/4	21.50
22	3-314LB	58" Kockums	8-7/8 x 3 x 3/4	21.50
96	3-315	58" Kockums Half Chipper	10-1/2 x 5 x 3/8	19.25
7	4-400	Jackson Chipper	12-1/2 x 8 x 1-1/4	108.00
48	4-402	Jackson Chipper	14 x 6 x 5/8	55.00
13	4-403A	Jackson Chipper	33 x 8 x 1-1/4	240.00
44	5-509A	56" Soderhamn Half Chipper	9-13/16 x 6 x 7/8	46.50
35	5-14C	Carthage Lily Pad	1-1/2 x 4 x .450	7.25
93	5-514T	Carthage Lily Pad	1-1/2 x 4 x .490	7.50
28	5-517	66" Soderhamn Half Chipper	21-1/2 x 4 x 3/8	25.50
12	5-523B	75" Soderhamn	23 x 5 x 1/2	38.50
134	5-524	75" Soderhamn Half Chipper	11-1/2 x 5 x 1/2	22.50
284	5-525	75" Soderhamn Half Counter	11-1/2 x 2-7/8 x 3/8	12.50
26	5-525A	75" Soderhamn Count.	23 x 2-7/8 x 3/8	16.50
30	5-528	Soderhamn Chipper	14-3/8 x 6 x 5/8	35.00
23	5-560	75" Forano Count.	23-1/2 x 2-3/4 x 3/8	24.25
90	5-568R	Soderhamn Wing Knife	1-3/8 x 2-61/64 x 31/64	6.50
58	5-569L	Soderhamn Wing Knife	1-1/8 x 2 x 3/8	6.50
41	5-569R	Soderhamn	1-1/8 x 2 x 3/8	6.50
106	6-603D	Hansel Half Chipper	11-1/2 x 5 x 1/2	19.00
13	6-603S	Hansel Half Chipper	11-1/2 x 5 x 1/2	19.00
74	6-607D	45" Nicholson Chip.	14-3/4 x 4 x 3/8	25.00
54	6-625C		20-1/2 x 4 x 3/8	23.50
23	7-720	Chip King #60 Count.	20 x 3-3/4 x 7/16	33.50
10	8-1107	Newland Chopper 18" Glass Fiber Chopper	15-1/2 x 5 x 3/4	40.95
106	8-116A	Adco West Edger	1-9/16 x 3-1/8 x 3/4	15.00
32	8-1116B	Adco West Edger	1-7/16 x 3-1/2 x 29/32	15.00
60	8-1116C	Adco West Duckbill	1-9/16 x 3-1/2 x 1	15.00
59	8-1116CR	Adco West Duckbill	1-9/16 x 3-1/2 x 1	15.00
17	8-1213	Adco West Top Chip Head Knife	2.8 x 4-11/32 x 1.56	26.00
23	8-1383	Comact	14-3/8 x 5-3/8 x 5/8	35.00
6	8-1383SQ	Comact	14-3/8 x 5-3/8 x 5/8	60.00
35	8-813	66" Precision Chip.	21-1/2 x 4 x 3/8	26.00
549	8-822L	Arasmith Lily Pad	1-3/4 x 4 x 1/2	7.00
207	8-822C	Arasmith Lily Pad	1-5/8 x 4 x 7/16	7.00
122	8-822E	Arasmith Lily Pad	1-3/4 x 4 x 1/2	7.00
26	8-822HR	Arasmith Lily Pad	2-3/16 x 4-3/8 x 1	16.00
50	8-822S	Arasmith Lily Pad	2-1/8 x 4 x 1/2	16.00

QTY.	KNIFE NO.	MACHINE	SIZE	SALE PRICE
37	8-822V	Arasmith Lily Pad	2 x 4 x 1/2	7.00
126	8-839A	Pallman PZ-6	7.04 x 2.269 x .315	6.00
15	8-854	Carthage Chipper	18 x 3 3/4 x 11/16	40.00
21	8-857H	Veneer Lathe Knife	54 x 7 1/2 x 5/8	125.00
6	8-858	Veneer Lathe Knife	56-1/2 x 7-1/2 x 5/8	130.00
24	8-877	Filer & Stowell	9 x 6-1/2 x 3/8	20.00
54	8-878	Filer & Stowell	1-29/32 x 6-1/2 x 3/8	11.00
50	8-880	Filer & Stowell - 2" Counter	1-29/32 x 5-3/4 x 3/8	15.00
160	8-899B	Beaver Canter	1-1/8 x 3-1/4 x 21/64	10.00
36	8-899E	Beaver Canter	1-1/2 x 3-3/4 x .325	10.00
334	8-899F	Beaver Canter	1-1/2 x 3-3/4 x .325	10.00
48	8-906A	Nicholson Half Coun.	14-5/16 x 2-5/8 x 3/8	14.00
25	8-930L	26" Nicholson V Drum	10-1/4 x 5-5/8 x 11/16	57.50
30	8-930R	26" Nicholson V Drum	10-1/4 x 5-5/8 x 11/16	57.50
284	8-971A		10 x 3-1/2 x 3/8	54.50
27	8-980L2	Can Car Edger	4-3/4 x 7-3/8 x 5/8	23.00
34	8-980LS	Can Car Edger	4-3/4 x 7-3/16 x 5/8	23.00
67	8-980R	Can Car Edger	4-3/4 x 7-1/8 x 5/8	23.00
36	8-980L5	Can Car Edger	4-3/4 x 7-1/4 x 5/8	23.00
28	8-980L4	Can Car Edger	6-11/16 x 8-1/2 x 5/8	32.00
32	8-980R1	Can Car Edger	4-3/4 x 7-1/2 x 5/8	23.00
18	8-980R2	Gan Car Edger	4-3/4 x 7-3/8 x 5/8	23.00
27	8-980R3	CNS Model 5000	7-3/8 x 9-3/4 x 5/8	36.00
12	8-991R3	CNS Model 5000	6-13/16 x 9.129 x .25	32.25
36	8-993	50" Can Car	14 x 4 x 5/8	22.35
22	9-935S		8-1/2 x 8-1/2 x 5/8	24.75
41	AA-1L		7-5/8 x 4 x 3/8	15.25
6	MKC-33	88" Murray	21 x 7-1/2 x 5/8	69.00
28	MKC-456	84" Soderhamn	28 x 6 x 1/2	55.75
12	MKC-493	Carthage	31 x 5 x 1/2	46.25
29	MKC-497	Carthage	28 x 5-3/4 x 5/8	68.00
124	MKC-54A	48" Fulghum Chipper	14 x 4 x 3/8	18.25
36	MKC-54D	48" Fulghum Chipper	14 x 4 x 3/8	18.25
37	MKC-54S	48" Fulghum Chipper	14 x 4 x 3/8	18.25
69	MKC-570R	Adco West	3 x 4-13/16 x 3/4	11.35
69	MKC-571L	Adco West	3 x 4-13/16 x 3/4	11.35
20	MKC-73A	112" Carthage	27 x 5 x 1/2	45.75
7	MKC-73B	112" Carthage	27 x 6-1/2 x 1/2	56.75
15	MKC-75K	110" Murray	31 x 6 x 5/8	65.00
111	CH-308	48" Soderhamn	14-3/8 x 5-3/4 x 5/8	39.50
32	MKC-203H	84" Fulghum Half Chipper	13-1/4 x 4-3/4 x 1/2	21.50
12	MKC-204B	75" Fulghum Chipper	23-1/2 x 4-3/4 x 1/2	39.25
43	MKC-215	48" Fulghum Counter	14 x 4 x 3/8	19.50
31	MKC-215S	48" Fulghum Counter	14 x 4 x 3/8	16.45
47	MKC-242	75" Fulghum Chipper	23-1/2 x 5 x 1/2	42.25
62	MKC-242A	75" Fulghum Chipper	23-1/2 x 4-3/4 x 1/2	39.00
47	MKC-279	Bush Chip Gainer	5 x 3 x 1/2	17.00
15	MKC-7A	Carthage	14 x 5-1/4 x 3/4	48.45
25	MKC-81	41" Jackson Chipper	14 x 6 x 5/8	42.00
24	MKC-99	60" Bush Chipper	18 x 4 x 1/2	24.50
116	MKCW-505		27 x 6-1/2 x 1/2	57.75
18	MKCW-505P	Carthage	27 x 6-1/2 x 1/2	57.75
42	MKK-555		13 x 2-7/8 x 3/8	13.50
50	MKK-97	48" Fulghum Counter	14 x 2-1/2 x 5/16	10.50

DISSTON FACTORY LIQUIDATION SALE
Located in Seattle, Washington
Hartley Corp., Box 78009, 206-872-2000
Contact Bill Hartley

HEAT TREATING EQUIPMENT

GCA Vacuum furnaces, S/N 3700, Mod 242436 1320, S/N 4-1293LV, 24"W x 36"D x 24"H, 2400° F, Graphite hot zone, 480/3/60, 200KW, SCR cont, Honeywell redr/cont, dia latrol H/L Ramp/Soak Timers, Cap 1000# inert gas backfill sys w/20 HP 5000 CFM blower, 1,000,000 BTU, aircraft qual heat exchanger, alloy baskets w/elec fork lift loader and guide sys, excel cond, 1977	$95,000.00
Water Saver Inc, encl cooling for above CGA Vacuum furnace, mod 10-02-0078, S/N 71206	$ 9,500.00
Two Lindberg Tempering furnaces, mod 11-EC-243624-14A, 20KW, 460/3/60, 1400°, 24W x 36D x 24H, S/N 24519, 24304 w. cont	Each....$18,000.00
Lindberg horiz draw furnace, 15KW, 230V, 10, 1300° F, 18W x 36D x 18H, w/cont	$ 4,000.00
Heavy duty box furnace, S/N 44712, 12"W x 24"D x 8"H, 1850°, 14KW, 230/1/60, alloy hearth w/cont	$ 5,000.00
Lindberg vert pit furnace, mod 25-48EH, S/N 7218, 25"W x 48"D, 1250° F, 60 KW, 230/2/60	$ 5,500.00

DISSTON FACTORY LIQUIDATION SALE
Located in Seattle, Washington
Hallidie Machine, 2200 6th Ave., 206-583-0600
Contact Warren Barlow

ELECTRICAL

20 Odd new elect motors 1/3, 1/2, 3/4, 1, 1½, 3, 7½, 15 HP	Best Offer

SHAPER/PLANERS

Rockford Opensided hyd, 24 x 72" table 15 HP, 220/440/3/60	$ 5,250.00
Rockford Opensided shaper planer, hyd, S/N 68UH33, 22 x 72 table, 10 HP, 220/440/3/60	$ 7,500.00

MILLERS

Cincinnati miller, 4-48, 14 x 72 table, overarm support, rise & fall, 10 HP, 460/3/60, S/N E5694	$ 6,000.00
Cincinnati miller, bed type, #218224, rise & fall, 11 x 48 table S/N 2-24R&F	$ 6,000.00
Hitachi Seiki mod 3ML-P plain mill, 63 x 13-3/4 table, travel range 33-3/8 long, 13-3/4 cross, 19-5/8 vert. speeds 30-1500 RPM, 10 HP, univ mill attach, 1966, S/N 5627	$15,500.00

LATHES

Cincinnati CTC Univ Turning Ctr, 20/12" x 72" Ctr w/acramatic IV cont, hdstk, 1600 RPM, 30 HP, 3" thru hole, 12" Cushman power chuck, w/hi-lo cont, steady & follow rests; S/N 53045A5V-34, 1970	$40,000.00

GRINDERS

Mattison Horiz Surface Grinder, 12 x 60" chuck, var cont, auto downfeed, trave-trol remote Timken bearings, 20 x 3" wheel coolant system, 15 HP, S/N 20526, 1966, 220/440/3/60	$60,000.00
Mattison horiz surface grinder, 14 x 72" chuck, neutrol cont coolant sys, 15 HP, 20 x 3" wheel, S/N 16857, 220/440/3/60, 1948	$38,000.00
20 x 3" wheel, S/N 16857, 220/440/3/60, 1948	$38,000.00

SAW

Grob Horiz Band Saw, 24" table, type NS18, S/N 4193, weler snagger, var speed, auto feed	$ 3,000.00

MISCELLANEOUS

Smog Hog, ½ HP, S/N SH20C16718	$ 1,500.00
Arbor Press, S/N 2898, 11" Throat	$ 500.00

ALL MACHINERY SUBJECT TO PRIOR SALE
AVAILABLE IMMEDIATELY
FREE LOADING ON YOUR TRUCK

Michigan Knife recently acquired the Disston Machine Knife business in Seattle, Washington. The entire business was moved to Big Rapids, Michigan. Through the melding of the two knife plants the following equipment has become available for liquidation.

DISSTON FACTORY LIQUIDATION SALE

Located in Big Rapids, Michigan
Contact Michigan Knife Co., 616-796-4858
(Free loading on your truck)

LIFT TRUCKS

Fork Lift, Barratt Elec, Rider w/chgr., 15' lift, 4000# cap, canopy, solid tires	$ 4,650.00
Fork Lift, Clark LP 5000#, solid tires, 10' lift, 1974 Model, S/N C50050-202-2528	$ 6,000.00

HEAT TREAT

Hoskins Elec Heat Treat Furnace w/cont panel, hor box type, 2400° max., 12'W x 8"H x 32"D chamber	$ 750.00

SAW

16" Woodcutting radial arm saw, Comet	$ 675.00

GRINDERS

Hanchett 60" Strt wheel magnetic chuck knife grinder w/coolant tank, S/N GK1458	$12,500.00
Gockel Vert Spindle 14 x 72" mag chuck grinder, 1975, S/N 5782, w/coolant sep system	$49,500.00
Mattison Vert Spindle, 100HP, 18 x 144", S/N 400-226, w/Barnes coolant system	$85,000.00
Carboloy double end disc grinder w/pedestal	$ 400.00
12" Abrasive/8" belt grinder w/pedestal	$ 650.00
#2 Oakley cutter grinder	$ 250.00

MILLER

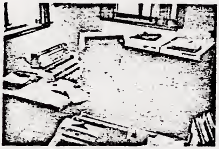
Cincinnati tracer milling machine, 4 heads	$26,500.00

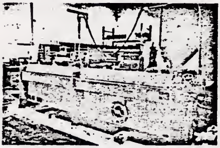
ELECTRICAL

Diehl Motor Gen Set, 6 KW, 125V, 50 AMP, 1200 RPM, DC, w/cont, 15 HP	$ 1,250.00

MISCELLANEOUS

Norton Dynamic Balancer, 48", 1HP, 500-1500 RPM, S/N 468	$ 1,200.00
1976 B700 Burroughs Computer w/B711 Processor, B9343 Printer A9249-1 Line Printer 250, A9480-22 Disc Drive, 220V, 30, presently operating, have replaced with larger computer	$ 7,500.00
1971 Stamas Fiberglass 26', 440 Chrysler engine rebuilt professionally, depth finder, trailer, cruise control, excellent fishing boat, vee hull, canvas	$12,000.00


B 700 BURROUGHS COMPUTER


120" KNIFE GRINDER

120" MICHIGAN KNIFE USED TRAVELING HEAD KNIFE GRINDER

Built 1981, Used 6 months to regrind chipper knives, Taken in on trade, 10 HP, coolant system, 90 day parts, only warranty, auto bar turner, 220/440 Volt, 3 0, 60 cycle, Mechanical Knife Bar reconditioned by our factory, Serial No.: 250, F.O.B. Big Rapids

Original List: $26,695.00 **Sale Price: $19,900.00**

PARTS SALES

Each month thru the use of the "MORBARK FLYER" we would like to offer additional Parts at considerable savings to our customers. These parts will be categorized in the following ways: "Monthly Sale Items", "Used and/or Rebuilt" Parts", and "Excess and/or Obsolete Parts". If your needs require other parts, we suggest you contact us since it is impossible to list all used and obsolete parts we have available in this issue.

Each monthly Flyer will be updated to reflect changes in the status of each part concerning prices, additions and deletions.

As outlined on page 143 of our 1983 Equipment Catalog, additional discounts are available with some quantity and volume orders.

Since our catalog has been out we have discovered several typographical errors, so we will have a section in this flyer to keep you updated on these errors and any other corrections which may come up.

Quantities of the parts listed in this flyer are subject to prior sales.

MORBARK PARTS DISCOUNT PROGRAMS

Besides our normal WHOLESALE prices, we offer a volume discount as outlined here. If you would refer to page 378 of our 1983 Equipment Catalog, you will find our Special Chipper Knife Discount Program.

VOLUME DISCOUNT STRUCTURE

Order Totals		Discount
$2,000.00 - $3,499.99	=	5%
3,500.00 - 4,999.99	=	7%
5,000.00 - and over	=	10%

TERMS: 5% 10 DAYS, NET 30 DAYS — (If paid within 10 days of our invoice date you can deduct 5% off the invoiced amount of the parts.)

"FLYER SALE ITEMS"

Prices effective 5/15/83 to 6/30/83

Each month we will run a SALE on some current, fast moving parts which are listed in our 1983 Equipment Catalog.

FLYER SALE ITEMS

PART NO.	DESCRIPTION	CATALOG PAGE NO.	CURRENT WHOLESALE PRICE	FLYER PRICE	FLYER ORDER QTY.	FLYER QTY. PRICE
24256-102	WSD 110 Chain	199	$18.31/ft.	$14.06/ft.	25' or more	$ 12.62
30277-010	15" Shear Knife	394	161.50	150.00	6 or more	125.00
30219-021	20" Shear Knife	394	446.25	400.00	4 or more	325.00
40190-440	Cutterhead, Em. 440, 636, 640	402	677.14	640.00	2 or more	550.00
39237-005	Shoe Insert, C, E, LP, 440, 636, 640	406	9.35	8.00	5 or more	7.00
30270-750	75" Chipper Holder	368	136.09	112.00	6 or more	107.00
4000X-750	75" Conventional Clamp	361	209.42	195.00	6 or more	175.00
26838-085	Filter Element	332	18.20	16.50	2 or more cases	14.50
40141-440	Top Wheel, 440, 636, 640	408	319.07	285.00	3 or more	260.00

NEW AND IMPROVED!

30" Cat Chain For Your Model 22RXL Total Chiparvestor

Morbark has developed a new Double Drive Cat Chain for the Model 22RXL Total Chiparvestor.

This new Chain has many advantages over the old style single drive chain.

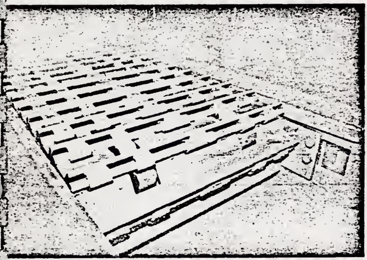
1. By moving the drive and idler sprockets to the outside, we have greatly reduced excessive loads on the drive shaft, the chain pins and the wear bushings.
2. Wear will be greatly reduced on the drive and idler sprockets. This is accomplished by increasing from a single sprocket to the double.
3. The wear bushings have been increased by 50%. This should increase the life of these bushings by over 100%.
4. By increasing the wear bushings we have also increased the tensile strength of the chain.
5. The drive and idler sprockets are now machined on a computer controlled machine. This will insure uniform pitch and centricity.

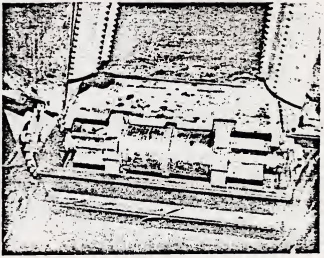
$AVE — $AVE — $AVE

As an introductory and an incentive to update your machines, Morbark will be running a SPECIAL SALE on the new Double Drive Chain and its Sprockets at the "EXPO 83" Show in New Orleans, May 20-22, 1983. An extra 15% EXPO discount will be deducted from the already discounted Wholesale price.

EXAMPLE	**SHOW**	**NORMAL**
(4) 40307-850 Double Drive Cat Chain @ $627.86 ea. =	$2,511.44	
(1) 40291-850 Double Drive Sprocket	400.93	
(1)- 40292-850 Double Idler Sprocket	360.62	
	$3,272.99	$3,272.99
Less 15% EXPO Discount	(490.95)	
	$2,782.04	
Less 10% Volume Discount	(278.20)	(163.65) (5%)
	$2,503.84	$3,109.34
Less 5% Cash Discount	(125.19)	(155.47)
(if paid within 10 days of invoice)	$2,378.65	$2,953.87

A $avings of $575.22 or 19% if purchased at the show.





"USED AND/OR REBUILT"

These are parts which have been replaced on equipment sent in for rebuild. Some have been rebuilt or reconditioned and others will be sold as is. These parts will be covered by a 30 day 50/50 warranty.

CHAR-LYNN HYDRAULIC MOTOR 8,000 SERIES, REBUILT

PART NO.	VENDOR PART NO.	DISPLACEMENT	SHAFT	PORT SIZE	LIST PRICE	FLYER PRICE
26731-501	MD080-28	28 Cu. In.	STR Key 2¼"	1¹⁵⁄₁₆-12	$1,118.00	$ 559.00
26731-503	MD080-57	57 Cu. In.	STR Key 2¼"	1¹⁵⁄₁₆-12	1,185.00	592.50

TRW ROSS GEROLOR HYDRAULIC MOTORS REBUILT

PART NO.	VENDOR PART NO.	DISPLACEMENT	SHAFT TYPE	SHAFT SIZE	PORT SIZE	LIST PRICE	FLYER PRICE
26726-041	MAB24-002-A1	17.8 Cu. In.	Splined	1"	⅞-14	$280.58	$193.04
26726-081	MAE34-002-A1	29 Cu. In.	Splined	1"	⅞-14	597.41	406.24

"EXCESS AND/OR OBSOLETE PARTS"

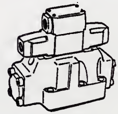
These are parts we have found ourselves overstocked in or parts which have become obsolete in our current production.

OREGON CHAIN SAW ACCESSORIES

DESCRIPTION	VENDOR PART NO.	LIST PRICE	FLYER PRICE
Drive Sprocket	44749	$ 30.00	$15.00
Roller Nose	11617	36.00	18.00
Chipper Chain	10AC-94E	31.00	18.50
Chipper Chain	10AC-88E	34.96	17.48
Drive Hub	118C	29.50	14.75
3½' Saw Bar	11716	163.00	81.50
3' Saw Bar	11421	155.56	77.78

SPLINE SHAFTS

PART NO.	DESCRIPTION	LIST PRICE	FLYER PRICE
150 x 8½	Full Key Spline Shafts 1½ x 8½	$49.70	$19.49
150 x 9	Full Key Spline Shafts 1½ x 9	50.28	19.72
150 x 9½	Full Key Spline Shafts 1½ x 9½	50.85	19.94
150 x 10	Full Key Spline Shafts 1½ x 10	51.40	20.16
150 x 10½	Full Key Spline Shafts 1½ x 10½	51.73	20.29



VICKERS SOLENOID OPERATED DIRECTIONAL CONTROL VALVES, DRY COIL

PART NO.	VENDOR PART NO.	VOLTAGE	TYPE	LIST PRICE	FLYER PRICE
26678-201	DG5S4-060CE-24DC-51	24VDC (DRY)	Open Center, Ext. Pilot	$346.00	$136.47
26678-232	DG5S4-068-CX-T-R-24D-51	24VDC (DRY)	Tendem Center, Int. Pilot	404.00	184.85

2500 PSI HYDRAULIC CYLINDERS

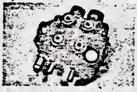
PART NO.	VENDER	VENDOR PART NO.	BORE X STROKE	CLOSED CENTER	LIST PRICE	FLYER PRICE
26818-014	Texas HYD	TL1510012C-B	1½ x 10	19¼"	$ 65.40	$32.70
26818-058	Texas HYD	TL3012018C-B	3 x 12	22¼"	102.56	51.28
26818-070	Texas HYD	TL4008024C-B	4 x 8	18¼"	135.44	67.72

ELECTRIC MOTORS 3 PHASE 220/440V, NEW

PART NO.	H.P.	R.P.M.	FRAME SIZE	MAKE	LIST PRICE	FLYER PRICE
27972-661	2	1800	184F	Newman	$ 158.40	$ 93.18
27973-081	3	3600	184F	Newman	158.76	93.39
27973-062	3	1800	182T	Newman	211.68	124.52
27963-061	3	1800	213U	Newman	158.40	93.18
27964-342	15	1200	284T	Delco	450.80	265.18
27967-062	75	1800	405U	Newman	4,773.00	2,386.50
27967-362	100	1800	444U	Newman	5,756.00	2,878.00
27974-474	25	3600	256T	Lincoln	870.00	485.35

FABRICATED ASSEMBLIES

PART NO.	DESCRIPTION	CATALOG PAGE NO.	LIST PRICE	FLYER PRICE
40245-021	20" Shear Holder - 2½"	395	$2,301.39	$1,380.83
40246-021	20" Shear Holder - 2½"	395	2,301.39	1,380.83
42142-614	NW Top Infeed Wheel LH	408	403.40	272.20
42139-614	NW Top Outfeed Wheel LH	409	448.16	297.94
42027-614	NW Infeed Shoes and Shaft RH	405	504.53	232.08
42027-614	NW Infeed Shoe and Shaft LH	405	504.53	232.08



GRESEN SPYT MONO BLOCK VALVES WITH HANDLES

Page 264 in catalog

PART NO.	VENDER NO.	SPOOL NO. 1	SPOOL NO. 2	SPOOL NO. 3	LIST PRICE	FLYER PRICE
26664-401	SPYT-D3	D3	—	—	$136.61	$ 88.71
26664-403	SPYT-D3-DF4	D3	DF4	—	217.49	141.22
26664-406	SPYT-4	4	—	—	124.79	81.03
26664-407	SPYT-4-4	4	4	—	186.67	121.21
26664-418	SPYT-4-4-D3	4	4	D3	260.40	169.09

HARDENED SPLIT STEEL BUSHINGS

Page 168 in catalog

PART NO.	O.D.	I.D.	LENGTH	LIST PRICE	FLYER PRICE
23128-011	2	1½	1¼	$7.60	$4.47
23128-012	2	1½	1½	8.60	5.06
23128-014	2⅜	2	1½	9.12	5.36

BUNTING BRONZE BUSHINGS

Page 168 in catalog

PART NO.	I.D.	O.D.	LENGTH	LIST PRICE	FLYER PRICE
23126-025	1¼	1½	3½	$20.22	$11.89
23126-031	1⅝	2	3	23.68	13.93
23126-045	2	2½	4	43.92	25.84
23126-051	2½	2¾	4	38.20	22.47
23126-052	2½	3	4	54.72	32.19
23126-055	2¹⁵⁄₁₆	3⁷⁄₁₆	3½	32.76	19.27
23126-061	3	3⅝	4½	69.12	40.66
23126-071	4	4½	4	89.84	52.49

SAVAGE AND CROWN LOADER PARTS

DESCRIPTION	VENDOR PART NO.	VENDOR	LIST PRICE	FLYER PRICE
Grapple Cylinder	1161	Savage	$335.94	$264.75
Live Heel Cylinder	1186	Savage	843.32	632.49
Live Heel Cylinder	1503	Savage	684.53	513.40
Jib Boom Cylinder	1557	Savage	795.53	596.65
Swivel Joint	1164	Savage	79.44	59.58
Bucket Cross	L-6012	Savage	126.64	98.48
Clevis	B-6008	Savage	154.69	116.17
Rotator Assambly	28-012	Crown	154.69	116.17
Timkan Cup	522	Crown	16.12	8.06
Timken Cone	529	Crown	29.72	14.66
2" Nul with set screw	SC-8027	Savage	10.82	8.75
2" Lock Nut	SC-8008	Savage	15.41	11.56
1" Splinad Insert	6039	Savage	17.60	9.45
Cushion Vaive (Gresen DXV50)	SC-5502	Savage	103.81	77.85
Bearing Cona	SC-7506	Savage	11.83	8.87
Bearing Cup	SC-7507	Savage	5.81	4.21

STEEL PLATE SPROCKETS

Center Bores as Listed Below

CHAIN SIZE	NUMBER OF TEETH	BORE	LIST PRICE	FLYER PRICE
60	21	1¾ Hub	$ 14.00	$ 5.79
60	21	2⅞	14.00	5.79
80	26	1⁷⁄₁₆ Hub	16.00	5.94
60	30	2½	18.20	6.77
60	48	1	30.54	11.36
60	48	5½	30.54	11.36
60	54	1	35.80	13.32
60	60	2¹⁵⁄₁₆	44.20	15.44
80	10	1	12.43	4.63
80	14	1	14.17	5.27
80	21	1	20.71	7.70
80	21	2½	20.71	7.70
80	21	3⅞	20.71	7.70
80	28	1	28.78	10.70
80	28	2	28.78	10.70
80	28	5⅞	28.78	10.70
60	38	1	44.91	16.70
80	45	2½	57.55	21.41
80	45	2¹⁵⁄₁₆	57.55	21.41
80	60	1¼	102.46	38.12
60	60	2¹⁵⁄₁₆	102.48	38.12
100	12	3⅞	16.44	7.02
100	38	1¼	84.40	36.03
100	40	1¼	94.80	40.46
100	40	5	94.80	40.46
100	45	2¹⁵⁄₁₆	118.00	50.37

DODGE CHAIN COUPLER HALF

80 Chain 20 Tooth Style F
For 3020 Bushing
Our Part No.: 24333-121

List Price	Flyer Price
$98.60	$58.00

STEWART WARNER

Mechanical Temperature Gauge
For Coolant or Lubricant 100° to 250°
Part No.: D-361-CC-72

List Price	Flyer Price
$28.16	$12.80

DELTROL RELIEF VALVE

Part No.: RV-6
Sat at 1500 PSI - ¾" NPT Ports

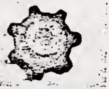
List Price	Flyer Price
$76.26	$39.46

GRESEN MID-SECTION INLET

Part No.: 1886
Our Part No.: 26664-336

List Price	Flyer Price
$36.71	$20.96

CONVEYOR CAST SPROCKET



Fo -188 Chain - 7 Tooth - $1\frac{7}{16}$ Bore

ist Price	Flyer Price
$87.60	$30.66

SLIP YOKE

1¾ 10 Spline - $1\frac{3}{32}$ Free Hole In Flange
With Dust Caps and Washers

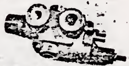
List Price	Flyer Price
$155.88	$62.35

END YOKE

2" Round Hole with key way
$\frac{13}{32}$ Free Hole In Flange
Our Part No.: 24112-175 - 62N Series

List Price	Flyer Price
$126.20	$50.48

DELTROL MODEL D40



Single Spool Directional Control Valve
¾" NPT Ports
Spring Return to Neutral
3-way Tandem Center
Part No.: D40-DA-3

List Price	Flyer Price
$118.76	$59.38

WIRE ROPE SHEAVE

Bronze Bushed
8 OD x 1⅝ wide x ¾ ID
Our Part No.: 24211-823

ist Price	Flyer Price
$73.26	$36.63

SPLINE PLUG

1¾ 16 Spline For 3 OD x .120 Wall Tube
Rockwell 50 NPS28-31
Our Part No.: 24112-180

List Price	Flyer Price
$98.76	$39.50

CROSS & BEARING KIT

4-Low Wing Bearings with ⅜"-24
Threaded Holes Rockwell CP62N-47
Mechanics 114-6143
Our Part No.: 24112-172

List Price	Flyer Price
$98.50	$46.35

2 GROOVE 18.0" PITCH DIA. SHEAVE
QD-SF STYLE BUSHING

Our Part No.: 24223-914

List Price	Flyer Price
$145.80	$77.06

END YOKE

1½" Round Hole - L16 Series
Rockwell L16SYR24

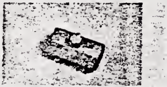
ist Price	Flyer Price
$35.60	$14.24

WELD YOKE

$\frac{13}{32}$ Free Hole in Flange for 3 OD x .120
Wall Tube - Rockwell 62NY44
Our Part No.: 24112-171

List Price	Flyer Price
$108.21	$43.28

HY-PNEU CHECK VALVE STEEL



½" NPT Ports
Our Part No.: 26631-185

List Price	Flyer Price
$17.12	$8.62

FAFNIR BALL BEARING INSERT

2" Bore - 3.9377" O.D.
Part No.: G1200-KRR
Our Part No.: 23262-025

List Price	Flyer Price
$42.50	$25.00

SPLINE PLUG

¾ pline - For 3 OD x .120 Wall Tube
Rockwell 62NPS28-13
Our Part No.: 24112-179

List Price	Flyer Price
$88.91	$35.56

SLIP YOKE

1¾ 16 Spline $\frac{13}{32}$ Free Hole in Flange
with Dust Caps and Washers
Rockwell 62NLS28-2
Our Part No.: 24112-178

List Price	Flyer Price
$187.47	$74.99

MICROMETER NEEDLE VALVE
DELTROL FLUID PRODUCTS

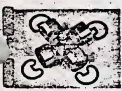
M201 S4, ¼" NPT Male &
Female Ports - Steel
Our Part No.: 26642-003

List Price	Flyer Price
$19.00	$8.50

SEAL MASTER BALL BEARING INSERT

$1\frac{7}{16}$" Bore - 2.4409" O.D.
Part No.: ER-19
Our Part No.: 23613-211

List Price	Flyer Price
$26.46	$15.56



UNIVERSAL JOINTS
CROSS & BEARING KITS

RT NO.	DESCRIPTION	LIST PRICE	FLYER PRICE
13-104	CP-35R For 1½" U-Joint	$26.99	10.30
24113-106	CP-55 For 2" U-Joint	68.87	27.55

UNIVERSAL JOINTS
ROCKWELL

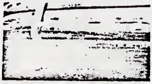
PART NO.	DESCRIPTION	LIST PRICE	FLYER PRICE
24113-005	1¼" Spline to 1¼" Spline (10 Spline)	$27.48	$13.63
24113-007	1¾" Spline to 1¾" Spline (16 Spline)	61.00	29.86
24113-024	1" Round to 1" Round	21.36	8.14

FLANGE BEARING

SEAL MASTER — SF-26 1⅝"
4⅛ Bolt Centers ½" Bolt

List Price	Flyer Price
$42.60	$20.25

SYNTHETIC COVER HYDRAULIC HOSE



K410 - Hytron - ⅝" ID - Imperial Eastman

List Price	Flyer Price
$3.10/ft.	$.92/ft.

MORSE CONTROL ASSEMBLY DUAL CONTROL

Part No.: E44716-1

List Price	Flyer Price
$48.65	$22.10

CHAIN LINK ATTACHMENTS

No. C55 Chain Style K2

List Price	Flyer Price
$4.67	$2.10

FLEET GUARD ADAPTOR HEAD

For LF-777 By-Pass Filter
Part No.: 3304173S
Our Part No.: 29214-218

List Price	Flyer Price
$49.98	$19.59

HUB WHEEL BOLTS

Fine Thread

Size	List Price	Flyer Price
⅝ x 1¾	$1.76	$.62
⅝ x 2¼	2.10	.79
9/16 x 1	1.81	.69

DRIVE SHAFT ASSEMBLY

For PS-8 Peelers with Chrysler Engine

List Price	Flyer Price
$173.60	$89.80

REXNOID PILOTED FLANGE BEARING

ZBR-200-G-2 · 2" Bore - 5⅞" Bolt Center

List Price	Flyer Price
$146.38	$73.19

HYDRAULIC IN-LINE SWIVELS WITH GREASE FITTING

¾" NPT Ports - 360° Rotation - S8-PF-12

List Price	Flyer Price
$21.60	$9.46

DUST CAPS FOR MALE COUPLERS

S49-4 for safeway
S 40-4 ½" NPT Coupler

List Price	Flyer Price
$2.15	$1.06

DUST PLUGS FOR FEMALE COUPLERS

S44-4 for Safeway
S-40-4 ½" NPT Couplers

List Price	Flyer Price
$2.15	$1066

HYDRAULIC QUICK COUPLER

BRUNING SM800
¾" NPT Ports

	List Price	Flyer Price
Male	$10.93	$ 4.69
Female	18.78	8.31
Complete	20.61	12.40

SELF ALIGNING BUSHINGS

20SF32 Bore 2" - OD 3.1875
Width: 1.750"

List Price	Flyer Price
$48.52	$28.54

DODGE TYPE E - 3½" CHIPPER DUTY PILOTED FLANGE BEARING

29341-541 - 3½" Bore
8⅝" Bolt Circle - ¾" Bolt

List Price	Flyer Price
$401.72	$236.31

MODEL SF100 SUMP TYPE FILTER

Gresen - 1¼" NPT Ports
60 Mesh Wire Screen - 26839-005

List Price	Flyer Price.
$38.00	$18.00

VICKERS HYDRAULIC FILTER ASS'Y. OFM-101-10

10 Micron - 1" NPT Ports
Cartridge Element

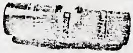
List Price	Flyer Price
$18.50	$7.25

MICHIGAN FLUID POWER SUMP FILTERS

2" NPT Ports - 100 Mesh

List Price	Flyer Price
$32.75	$16.90

CHAR LYNN MODEL IF301515 DOUBLE HYDRAULIC FILTER ASS'Y.



1¼" NPT Ports - Including filter condition indicator - Spin on elements

List Price	Flyer Price
$28.78	$14.22

DONALDSON PRE-CLEANER BOWL

Donaldson Part No.: P01-6330
Fits Precleaner PBH00-0254
Our Part No.: 29321-240

List Price	Flyer Price
$12.37	$6.41

DONALDSON PRE-CLEANER

Donaldson Part No.: PBH00-0254
Inlet Size: 3¾ I.D.
Our Part No.: 29321-217

List Price	Flyer Price
$38.10	$20.75

S UENCE VALVE FLUID CONTROLS INC.

With Built In Check - 0-600 PSI
S t200 PSI - ⅜" NPT Ports - Adjustable
Part No.: ISD12-P3-6S

List Price	Flyer Price
$93.46	$32.40

DODGE CHAIN COUPLING COVER

Size #60
Our Part No.: 24333-013

List Price	Flyer Price
$59.16	$30.40

DELTROL OUTLET SECTION

¾" NPT Top and Side Ports.
Part No.: D5-O-E

List Price	Flyer Price
$66.14	$32.41

BROWNING CHAIN COUPLING COVER

80Q
Our Part No.: 24331-032

List Price	Flyer Price
$60.60	$31.46

REXNORD PILLOW BLOCK BEARING

1½"-Bore - 1⅞" Shaft Height
For Some PS-8 Cutterheads
Part No.: ZA-108
Our Part No.: 23944-117

List Price	Flyer Price
$108.30	$63.53

DODGE CHAIN COUPLING COVER

Size #80
Our Part No.: 24333-015

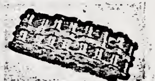
List Price	Flyer Price
$101.19	$52.80

DELTROL INLET SECTION

¾" NPT Ports Top and Side Ports
Part No.: D5-I-E

List Price	Flyer Price
$73.95	$34.98

COUPLING CHAIN ASSEMBLY



Dodge 8020 Chain
80 Chain 20 Teeth
Our Part No.: 24333-005

List Price	Flyer Price
$68.80	$40.47

BROWNING SHEAVE

6 Groove - R1 Bushing
"C" Section Belts
18" Pitch - 18.4" O.D.
Part No.: 6C180R
Our Part No.: 24223-515

List Price	Flyer Price
$299.78	$149.89

ROD CLEVIS

Texas Hydraulics
1" Dia. Pins - 1" Thread (Fine)
Our Part No.: 26818-102
Part No.: 60002

List Price	Flyer Price
$15.05	$7.60

DELTROL STACK TYPE DIRECTIONAL CONTROL VALVE

4-Way Open Center Float
Spring Return to Neutral - ½" NPT Ports
Part No.: D50-FA2

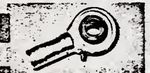
List Price	Flyer Price
$115.73	$63.65

SWIVEL ADAPTOR

90° 1½" NPT Each End - 360° Swivel
Part No.: PS24-PU24-P24
Our Part No.: 26591-029

List Price	Flyer Price
$199.00	$117.06

MALE ROD END



Self-Aligning - Bore 1"
Male 1¼"-12 TPI Right Hand
Part No.: TRE-16
Our Part No.: 23924-009

List Price	Flyer Price
$64.57	$37.98

PRICE TILE ROD HYDRAULIC CYLINDER

3" Bore x 10" Stroke
20¼" Closed Center Distance
1⅛" Dia. Rod - ½" NPT Ports - 1" Pins
Part No.: PMC-7110

List Price	Flyer Price
$99.18	$58.34

DELTROL STACK-TYPE DIRECTIONAL CONTROL VALVE

4-Way Tandem Center - 3-Position Detent
½" NPT Ports
Part No.: D50-AB2

List Price	Flyer Price
$114.66	$61.98

BROWNING CHAIN COUPLING COVER

80Q
Our Part No.: 24331-031

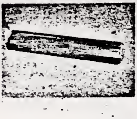
List Price	Flyer Price
$43.60	$22.64

AIR CONDITIONER UNIT

Climatrol Roof Mount - Complete

List Price	Flyer Price
$1,272.35	$826.20

CARBIDE VERTICAL ANVILS



PART NO.	CHIPPER SIZE	ANVIL SIZE	LIST PRICE	FLYER PRICE
40189-480	48"	12 x 3 x 1	$247.32	$123.66
40189-580	58"	15¾ x 3 x 1	297.42	148.71
—	75"	20 x 3½ x 1½	342.78	171.39
40189-750	75"	23 x 3½ x 1½	394.20	197.10

1983 EQUIPMENT CATALOG UPDATES

EQUIPMENT UPDATES

Page 38 — Options and Prices	
Reads: Chains (set)	$ 1,150.00
Should read: Chains (set)	$ 795.00
Page 42 — Options and Prices	
Reads: Chains (set)	$ 1,150.00
Should read: Chains (set)	$ 795.00
Page 82 — Options and Prices	
Line 1 — Reads: 1 set of kickers	$ 900.00
Should read: Automatic kickers	$ 2,500.00
Line 2 — Reads: Longer infeed @ 5'	$ 750.00
Should read: Longer infeed @ 5'	$ 900.00
Line 3 — Reads: Longer outfeed @ 5'	$ 2,500.00
Should read: Longer outfeed @ 5'	$ 750.00
Page 124 — Knife Grinders	
Wholesale Price reads:	$14,250.00
Should read:	$ 9,495.00
Page 126 — Options and Prices	
Reads: 72" Knife Grinder	$14,250.00
Should read: 72" Knife Grinder	$ 9,495.00

PARTS UPDATE

PAGE NO.	INCORRECT PART NO.	CORRECT PART NO.	LIST PRICE	WHOLESALE	QUANTITY
160	21422-566	21422-558	$ 1.05	$ .95	$ .79
180	—	23973-130	6.74	8.06	5.38
180	—	23973-135	18.78	16.88	15.01
180	—	23973-136	20.77	18.69	18.62
180	—	23973-137	34.85	31.37	27.88
180	—	23973-140	48.43	43.59	38.74
180	—	23873-148	72.73	65.48	58.18
183	—	24132-218	12.48	11.21	9.97
183	—	24132-241	13.63	12.26	10.90
183	—	24132-242	13.63	12.26	10.90
183	—	24132-243	13.63	12.26	10.90
163	—	24132-244	13.63	12.26	10.90
185	—	24185-048	171.04	160.71	147.09
188	—	24162-111	26.53	24.94	22.82
188	24211-317	Delete	—	—	—
199	—	24256-123	29.90	27.21	23.62
199	—	24256-124	29.90	27.21	23.62
202	—	24318-035	18.60	16.93	14.88
202	—	24318-043	18.60	16.93	14.88
217	—	24543-329	1,827.00	1,662.57	1,443.33
218	—	24559-075	12.81	12.04	11.02
218	—	24559-079	10.80	10.18	9.29
228	—	29811-228	.71/In.	.87/In.	.81/In.
234	25875-104	25975-104	18.84	17.14	14.88
234	25875-106	25975-106	40.28	35.65	31.82
250	26511-601	28814-601	76.58	69.67	60.48
250	26611-602	26814-602	78.58	69.67	60.48
251	—	28816-123	47.20	42.98	37.29
251	—	26816-124	47.78	43.46	37.73
251	—	26816-125	20.64	18.78	16.31
251	—	26816-126	47.75	43.46	37.73
265	—	26854-818	.88	.82	.58
271	26711-211	28711-221	41.60	37.88	32.88
272	—	28712-014	14.72	13.40	11.63
272	—	28712-641	84.81	77.00	66.84
274	—	26712-081	53.78	48.92	42.47
292	—	28731-004	2.31	2.17	1.98
296	—	26731-401	(14.0 Cu. In.)	—	—
296	—	28731-403	(23.0 Cu. In.	—	—
300	—	26731-810	469.00	430.32	391.20

PAGE NO.	INCORRECT PART NO.	CORRECT PART NO.	LIST PRICE	WHOLESALE	QUANTITY
307	26778-043	26728-042	54.84	48.80	43.32
311	—	26781-218	387.88	388.88	373.98
320	—	26812-381	18.52	16.01	13.41
325	40008-855	30008-988	61.88	53.08	44.42
325	26815-051	30006-955	61.69	53.06	44.42
325	—	85681-955	790.26	719.14	624.31
327	—	26821-078	2.06	1.87	1.63
328	—	28824-117	27.80	25.30	21.96
332	—	26838-088	—	—	—
350	29316-052	29317-082	90.50	82.38	71.50
350	29316-053	28317-053	73.60	88.88	58.14
350	29316-054	29317-054	18.90	15.38	13.35
355	—	29341-024	429.22	403.48	368.13
[2] 360	—	30280-750	194.55	165.37	136.18
[3] 360	—	30056-780	155.10	131.84	108.57
[4] 360	—	30052-750	118.02	100.32	82.81
[5] 368	40188-866	40186-866	204.35	181.67	163.28
392	—	30147-863	48.32	41.92	34.52
392	—	40101-855	653.68	888.31	522.94
393	—	40101-850	409.53	364.48	307.15
393	40264-850	40246-880	34.44	29.27	24.11
[6] 394	—	30211-010	17.48	14.87	12.24
395	40260-021	40266-021	1,794.27	1,525.13	1,255.99
402	40190-632	42190-632	726.35	668.24	581.08
404	30289-632	32189-632	72.58	64.80	54.44
404	32189-440	30189-440	75.73	67.40	56.80

[1] Quantity changed to 8 per case — Price remain the same

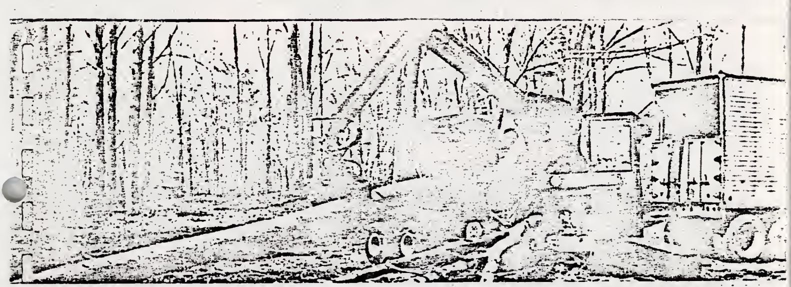
[2] Non-Seperator Top Discharge

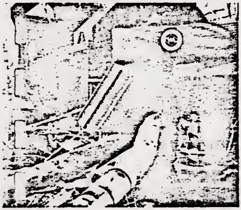
[3] Groove Front of Disc

[4] Seperator, Groove on Back

[5] Model 20

[6] Old Part No.: 021A0071H00



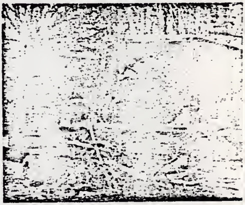


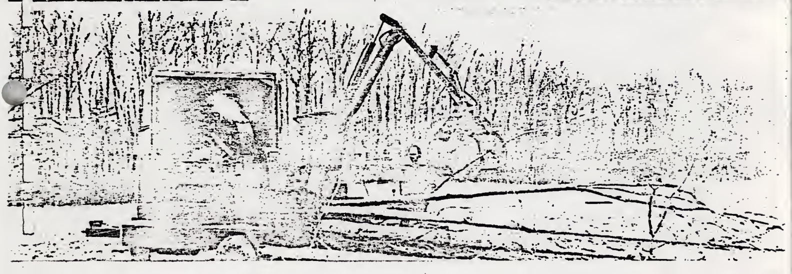
THE MODEL 30 TOTAL CHIPARVESTOR

This new machine is the most productive whole tree chipper ever built. It features a unique three point feed wheel system, a rugged back-hoe style loader and a large spout opening (a full 30"). Many power units can be used to suit individual requirements. See feature story for details.

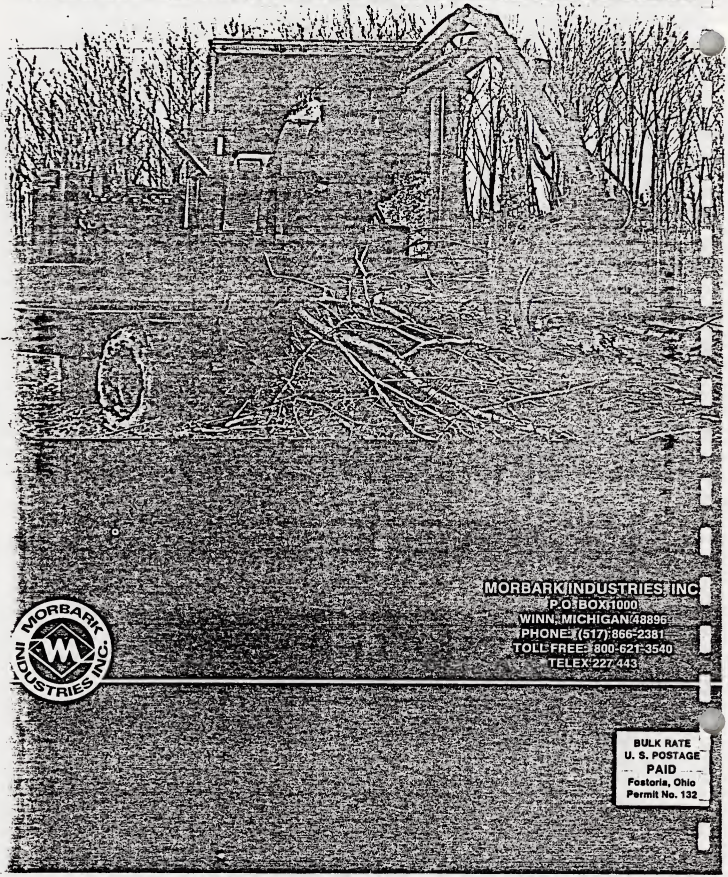
The Super Beever like the Model 30 has incorporated the same style feed system and loader into its design. The large spout opening allows multiple stem chipping and is well suited to handle brush and limby material. See this machine and the drop feed version at "Expo 83" in New Orleans.

THE SUPER BEEVER WHOLE TREE CHIPPER





A LOW PRICED WHOLE TREE CHIPPER WITH MULTIPLE STEM CAPABILITIES
SEE THE NEW SUPER BEEVER ON DISPLAY AT "EXPO 83"!



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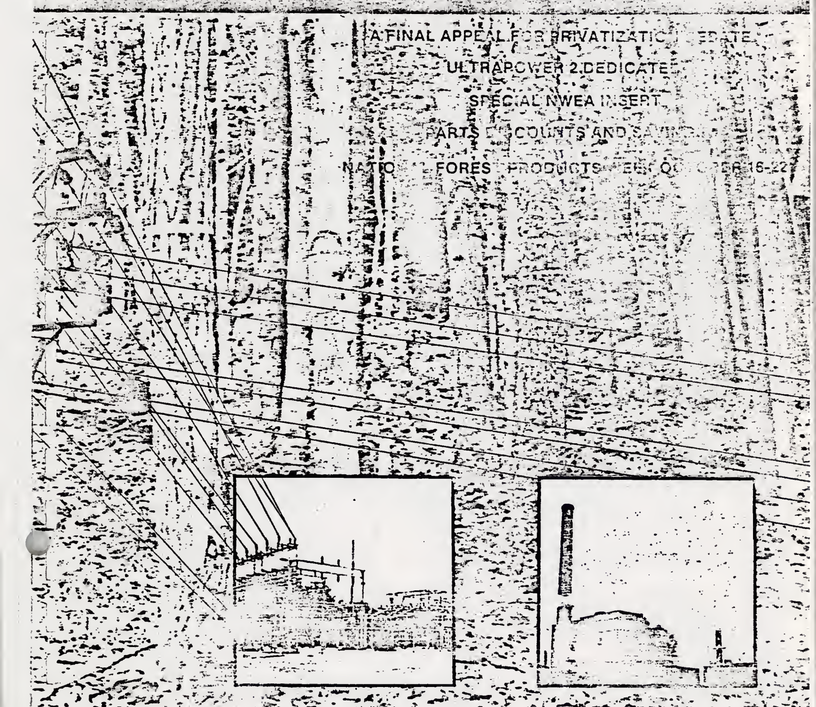
The Morbark Flyer

Volume No. [illegible]

September-October 198

WOOD ENERGY — COMMON SENSE ALTERNATIVE PROMOTED BY NWEA

ALSO IN THIS ISSUE



A FINAL APPEAL FOR PRIVATIZATION DEBATE

ULTRAPOWER 2 DEDICATED

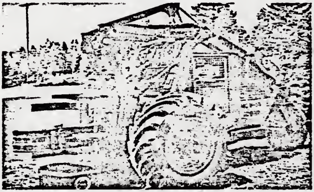
SPECIAL NWEA INSERT

PARTS DISCOUNTS AND SAVINGS

NATIONAL FOREST PRODUCTS WEEK OCTOBER 16-22

What's New At Morbark?

RECENT DEVELOPMENTS IN WOOD FIBER PROCESSING FROM MORBARK
THE LEADER IN WOOD FOR ENERGY

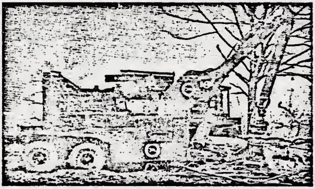


MOR-BELL RAPID BUNCHER

The versatile light weight Mor-Bell carriage equipped with a new high speed multiple stem felling and bunching shear. Capable of cutting and bunching over 400 stems per hour.

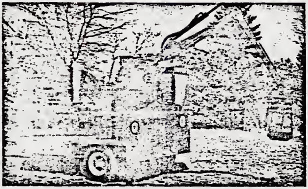
MOR-BELL LOGGER

The all-purpose Mor-Bell Logger can be used for sorting, skidding and loading forest products for multiple markets.



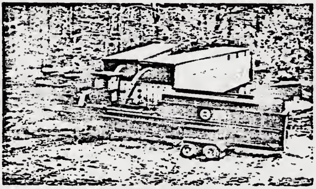
MORBARK MODEL 30 TOTAL CHIPARVESTOR

The new Model 30 is the ultimate in whole tree chippers. Built with a large spout opening and a unique feed system. It can accommodate a full 30" diameter stem, large bushy topped cull material or chip several multiple stems at one time.



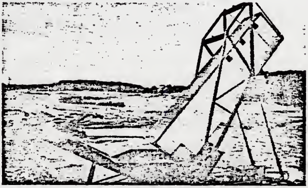
THE SUPER BEEVER WHOLE TREE CHIPPER

The Super Beever features the same style feed system and loader as the Model 30. The Super Beever is ideally suited and priced for processing logging residue and cull materal as well as multiple small diameter trees in a thinning operation.



MORTRAN SCREEN

This in-woods screening system is designed to process whole tree chips directly from a Total Chiparvestor. The Mortran Screen separates the high quality fiber used for pulp furnish from the lower grade material used as boiler fuel.



MOR-LIFT DUMP

Designed with the wood energy market in mind, the Mor-Lift offers a simple, fast and affordable chip van dumping method at a fraction of the cost of other systems.

The Morbark Flyer

Volume No. 6 September-October/1983

WOOD FOR ENERGY— JUST COMMON SENSE

Much has been written since the oil embargo of 1973 about the "Energy Crisis" and the media, the congress, environmental groups and the major oil companies and utilities have spent much time and effort debating the issue. We have been bombarded with Windfall Profits Taxes, Three Mile Islands, natural gas deregulations and conservation guidelines. We have employed thousands of accountants, attornies and bureaucrats at the Department of Energy, none of whom have generated one drop of oil or one kilowatt of electricity to actually solve the problem It is about time that we look at the situation and apply some plain common sense. It is about time that we look all around us and realize that our forest lands represent the only truly renewable resource that can be used today to help alleviate the problem.

The research has been done and the technology is developed. The economics is there to show that wood can out perform other heat sources. The waste fiber resource is available and will regenerate itself rapidly using sound forest management programs such as "Environmental Thinning."

Doesn't it make sense to properly utilize our wood fiber in small local facilities rather than to waste ever larger billions of dollars on Nuclear Plants that will probably never be operational? We think it does and believe there are thousands of you that think so too. We encourage you to write your congressional representatives to support educational programs that will tell the public of the vast wood energy potential. We encourage you to support the National Wood Energy Association to help get that message spread to industrial decision makers as well as the congress and the public. Let's work together to apply the common sense approach to our "Energy Crisis".....wood energy.

The cover photograph depicts our vast forest resource and the important role it can play in providing a solution to our "Energy Crisis".

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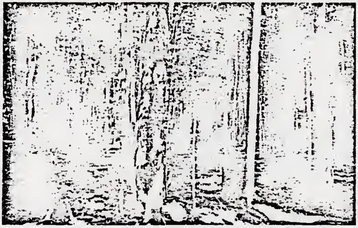
THE NATIONAL WOOD ENERGY ASSOCIATION NEEDS YOU



Morbark Industries has spent much time and effort advocating the benefits of utilizing this nation's vast supply of waste fiber as a source of energy. We recognize, however, that just because the economic incentives are there and we have the technology and equipment to harvest and handle this fiber, we still need to educate landowners, government officials and the public in general to help create the market and availability that is essential to reach our goals. This is why we support NWEA, The National Wood Energy Association.

The National Wood Energy Association is dedicated to:

ENCOURAGE through the use of responsible forest, agricultural and land management practices, public and private participation in the development of wood as a renewable energy source compatible with other wood uses;

UNITE in this cooperative effort small and large firms, public and private organizations, and individuals involved with, interested in and dedicated to the improvement and productivity of our nation's wood resource;

FOCUS consumer and legislative attention on this nation's greatest untapped renewable industrial energy resource and underscore its contribution towards economic strength and energy independence on national and local levels.

NWEA has now grown with memberships in over 47 states, but this has only scratched the surface. To be a truly influential and strong voice that can adequately work to provide the education that is necessary, it must dramatically increase its membership into the thousands. Whether you are a landowner, a chip producer, a consulting engineer, a forester, an equipment dealer or manufacturer, **NWEA Needs You.** Certainly the development of wood energy systems can result in direct business or economic benefits to you, but just consider the additional jobs in all phases of your local economy that would be affected by establishing wood fired systems in your area. Not only will jobs be created in wood producing, handling and transportation but also in service related areas required to support this industry. The overall tax base would be increased and the overall economy would be strengthened. But you must do your part now.

Help NWEA spread the word that wood energy is still more cost effective and dependable than oil in the long run.

Help NWEA educate legislators about the important role of wood energy in creating jobs and reducing the need for imported fuels.

Help NWEA represent our industry at trade shows across the nation, talking about energy economics, technology and positive results of forest management.

Help yourself to stay informed about the latest developments within the industry by receiving your monthly copy of "Biologue", covering trends, new products and timely articles.

Receive an "Industrial Wood Energy Directory" providing listings of equipment descriptions, specifications and capabilities.

Receive a "Publication Index" and have access to the "Case Study Library" providing references to books, reports and periodicals and materials about successful wood energy applications.

Help NWEA provide an information clearinghouse designed to accumulate details on new discoveries and research around the country and the world.

Help NWEA assist in the development of your local market and put you in touch with potential wood fuel users through its referral service.

If you are involved in the Forest Products Industry, then you should be involved in the National Wood Energy Association. We can accomplish more as a united industry that we can as individuals or separate companies. NWEA will allow us to work together and combine our strengths in promoting wood energy. Don't just sit back...act now and help yourself, the industry, your local economy and the nation. Join NWEA today and become a part of the effort to increase the membership by 10 fold, because we all must get involved.

A FINAL APPEAL FOR PRIVATIZATION DEBATE

By Lawrence W. Reed

Professor Reed is Chairman of the Department of Economics at Northwood Institute in *Midland, Michigan.*

The Bureau of Land Management is a sprawling federal agency with 5,000 employees and a budget of well over $1 billion. The overwhelming majority of federally-owned commercial timberland—millions of acres of it—is managed by the BLM and by the U.S. Forest Service. Selling off ("privatizing") some portion of that land has been proposed in this column as an idea worth considering. If done properly, it could alleviate the problem of poor management which often plagues public ownership. It would put resources in the hands of people who would conserve them because it would be in their private interest to do so. President Reagan's administration is now committed to moving seriously in this direction, representing a continuation of the principle of decentralized, private ownership on which the country was founded. What we really need is a full-scale, national debate on the issue.

Without a doubt, any sale of commercial timberlands from the national forests should be gradual. A reasonable policy might prescribe, let's say, sale by competitive bidding of 5% of the timberland by the end of the decade. Similar steps could be undertaken, incidentally, for the sale of other federal lands too. Early sales would provide clear indication of both potential revenues (needed to reduce the federal deficit) and the degree of potential improvement in management. If the privatization concept is indeed a good one, we'll see tangible benefits with which to make judgements about further sales.

In the past, conventional harvesting techniques tended to "take the best and leave the rest." The result was a devaluation of the land—physically and financially. This was especially true of land which was not owned privately. However, even many private individual landowners were reluctant to sell their timber because of these methods, causing many millions of acres of private land to go unhusbanded and wasted.

Though not without room for improvement, *industrial* management of timberland has tended in the past to be better than individual or government management. As pointed out in earlier columns here, resources or goods of any kind tend to be taken better care of if the owner(s) have a direct, commercial interest in preserving and maximizing current revenues, future income and capital values.

The "environmental (or selective) thinning" program for harvesting, which is lately attracting great attention, dovetails nicely with the privatization concept. It could make good forest management by private entrepreneurs even more profitable and hence, attractive. I direct the reader's attention to past issues of **The Morbark Flyer** for more detailed explanations of environmental thinning and its potential.

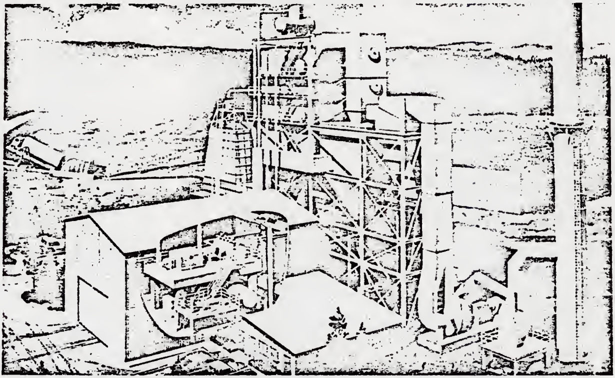
Nothing said in the limited space here compares, however, with the exciting work of Richard L. Stroup and John A. Baden of the Pacific Institute for Public Policy Research (635 Mason Street, San Francisco, CA 94108). In their new book, *"Natural Resources: Bureaucratic Myths and Environmental Management"*, Stroup and Baden explore in depth the idea of privatizing not only timberland but other federal lands as well. In their words, *"Efficient use of resources requires that decision makers have both the authority and the responsibility for the resources about which decisions are being made. A nationalized industry, whether in automobiles, the postal service or the forest, will simply not be efficiently managed. Contrary to popular belief, the problems that result from nationalization are the fault of bad information and incentive systems, not bad people. When the worst cases of externalities can be controlled, private and transferable property rights are the best way to link responsibility and authority consistently."*

I suggest that any reader who has been stimulated by the brief overview here of privatization get a copy of that pioneering book. If privatization does get off the ground as public policy, this book will be one of its blueprints.

My purpose in the last several issues of **The Morbark Flyer** has not been to spell out a detailed plan for privatization. Instead, my purpose has been to generate thought, inquiry, debate, further study. I want to see people who are directly involved with public lands or others in industry, forestry or conservation, begin to address the issue and work on the details. I hope that limited objective has been accomplished.

Future columns in ***The Morbark Flyer*** will deal with other issues of great importance facing us Americans.

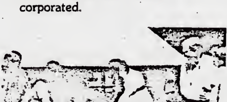
"ULTRAPOWER, INC. DEDICATES THEIR SECOND WOOD-FIRED ELECTRICAL GENERATING FACILITY"



Companies outside the Forest Products Industry are turning to wood as a major source of power. Ultrapower, Inc. is one example of a non-wood related company leading the way in the utilization of wood waste for energy.

A second Ultrapower wood-fired power plant, furthering one of the goals of the National Wood Energy Association, is under construction in Northern California. These $20,000,000 power plants will utilize waste wood gathered from the forest for their operating fuel and will each produce 11 megawatts of electricity—enough to satisfy the electrical needs of 10,000 homes.

The new power plant will operate under the name, ULTRAPOWER 2, and is a joint venture between Ultrapower (a wholly-owned subsidiary of Ultrasystems Incorporated) and Pacific Lighting Energy Systems (a wholly-owned subsidiary of Pacific Lighting Incorporated). This plant is located near the community of Westwood in Lassen County. Formal ground breaking ceremonies were held in July with over 400 persons present including a number of government and private dignitaries. These included James K. Coyne (President Reagan's Special Assistant for Private Initiatives); Chuck Imbrecht (Chairman of California Energy Commission); and Norval Morey (President of Morbark Industries). The festivities were hosted by Bob Kennel, Senior Vice President of Ultrapower Incorporated.



The project successfully proceeded to this point with excellent cooperation from both private and government organizations and will be completed in late 1984. The first Ultrapower project is under construction at Burney, California with formal ground breaking in October 1982 and completion in September 1984. Additional similar plants are planned in Northern California as well as around the United States.

Phillip J. Stevens, Chairman of the Board and Chief Executive Officer of Ultrasystems said, *"These new power plants represent an innovative concept in the field of power generation. These are among the first power plants in the United States which are based on using forest residue materials as the primary operating fuel for the plant. Virtually all other wood-fired power plants",* he continued, *"utilize waste wood which is derived as a by-product of some other forest product manufacturing operation, such as sawdust from sawmills which produce lumber, or waste materials obtained from pulp and paper plants. As a result of the concept of utilizing forest residue materials for fuel, our power plant approach is enthusiastically supported by the U.S. Forestry Service and private land owners.*

The forest residue materials which will be consumed by the power plant include slash (tops and limbs usually left in the forest), culls (rejected trees found unsuitable for use by the commercial forest product industry), and *forest thinning. It is generally agreed that the removal of these residue materials from the forest will environmentally enhance the forests by reducing the hazards resulting from fires and will also promote the growth of healthy trees in the forests. The new power plant,"* Stevens explained, *"will consume some 120,000 tons of wood per year. Since one ton of wood is equivalent to 1.4 barrels of oil, the new wood-fired power plant will save the country more than 160,000 barrels of imported oil per year."*

The Ultrapower concept is totally funded by private financing. The private financing is partially possible because of previous federal and state legislation such as the Public Utility Regulatory Policies Act (PURPA), which insures that the power produced can be sold at a fair rate and several laws which support an Energy Tax Credit for alternate and renewable energy production from waste sources such as wood and municipal refuse. Electricity generated by the power plant will be sold to the Pacific Gas and Electric Company under a long-term contract.

Stevens believes that the country is facing a potentially serious energy problem in the future, and unless the nation utilizes all of its resources wisely, including its waste wood resources, we will see a "dimming of America" as a result of an inadequate supply of electrical energy being available to meet the country's lighting and power needs. They believe the dramatic decline of the nuclear power industry is leaving the nation confronted with a "power gap", a gap which has been created as a result of the cancellation of more than 30 nuclear power plants since 1979, and a gap which will be exacerbated if additional nuclear power plants are cancelled—a possibility which is presently undergoing serious consideration.

Stevens concludes, *"We believe that our Ultrapower concept represents another example of good old American ingenuity, teamwork and know-how applied to a national need. In a small measure, we believe that these Ultrapower plants will help to make the nation less dependent upon imported crude oil as well as provide much needed electrical energy for the future."*

Ultrasystems, Inc., based in Irvine, California, is a rapidly-growing engineering and construction company involved in a wide range of high technology and innovative projects, including alternative energy projects, the design and construction of power plants as well as chemical, petrochemical and food processing plants. In addition, Ultrasystems is involved with numerous defense and space system projects.

Ultrasystems is a new member of the National Wood Energy Association but has been active in the development of wood energy for many years.

BLOWER ATTACHMENT USED TO RECOVER SEPARATED MATERIAL FROM WHOLE STEM CHIPPING APPLICATIONS

A South Carolina customer has developed a separator recovery system that he adapted to his Morbark Model 22RXL Total Chiparvestor to recover the separated material from the dirt separator.

Utilizing a Morbark 10-HP hydraulic driven chip blower which he attached to the frame of the chiparvestor, he then adapted the dirt separator discharge spout to the input area of the blower. He tapped into the hydraulic system providing oil from the feed system on the chiparvestor to provide the power to operate the blower.

The rejected material is blown into a separate van and carried to the papermill for fuel. This previously wasted material is recovered and used, and the blower has reduced the maintenance costs on the wood yards.

The cost of the hydraulic blower is $2,250.00, not including the cost of installing it on the chiparvestor, and adding the hydraulic control valve and hoses to operate the blowing unit. The hydraulic blower will not work for whole tree applications in that the twigs and limbs will plug the blower.

Anyone interested in adapting a blower to their Morbark Total Chiparvestor chipping stemwood should give us a call here in Winn, Michigan We appreciate the ideas submitted by our customers.

MODEL 12 TOTAL CHIPARVESTOR USED SUCCESSFULLY IN BRUSH RECYCLING PROGRAM

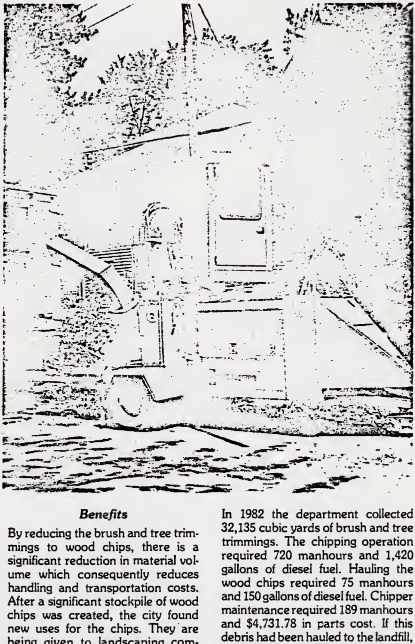
RICHARD I. PAULSON, P.E.,
Director, Public Works Dept.
Normal, Illinois

Many municipalities throughout the country are faced with handling increased volumes of brush, tree trimmings, and limbs from storm damaged trees. Usually this material is collected with open-body dump trucks and refuse packers, or chipped on the street. Debris disposal methods will vary widely if the material is collected utilizing open dump trucks.

The public works department of Normal collects brush and tree trimmings using a 30-cubic yard open dump body mounted on a 35,000-pound GVW chassis. Between the cab and truck body there is a knuckleboom loader. The knuckleboom loader mechanically picks up debris, loads the truck, and helps compact the load and increase its density. All debris collected is hauled to the public works facility for further disposition.

Prior to 1980 these materials were allowed to accumulate until 3,000 or 4,000 cubic yards of material were on hand. Smaller, 6-cubic yard dump trucks were utilized to haul the debris to the local landfill. The one-way distance to the landfill is ten miles through the urban area and requires a one-hour round trip. Many times the stockpiled debris was set on fire by vandals. This created a health hazard and a danger to the community. The volume of brush and tree trimmings has been increasing at an annual rate of 30 percent.

In 1980 the department began a search for an alternative means of disposing of the brush after it had reached the public works facility. Equipment was rented during 1980 with disappointing results. All equipment investigated reduced the brush to wood chips. In 1981 a Model 12 Total Chiparvestor, manufactured by Morbark Industries, was rented. This operation proved to be successful and the department ultimately purchased the unit.



Benefits

By reducing the brush and tree trimmings to wood chips, there is a significant reduction in material volume which consequently reduces handling and transportation costs. After a significant stockpile of wood chips was created, the city found new uses for the chips. They are being given to landscaping companies, to other city departments, and to other governing agencies for use as landscaping mulch. The Bloomington/Normal Sanitary District is experimenting with the wood chips as a bulking agent to dry and compost sludge from the wastewater treatment facility. Compost experimentation is ongoing. No wood chips are hauled to the landfill.

In 1982 the department collected 32,135 cubic yards of brush and tree trimmings. The chipping operation required 720 manhours and 1,420 gallons of diesel fuel. Hauling the wood chips required 75 manhours and 150 gallons of diesel fuel. Chipper maintenance required 189 manhours and $4,731.78 in parts cost. If this debris had been hauled to the landfill, the operation would have cost $59,771 in landfill costs, required 5,356 manhours and 5,356 gallons of diesel fuel. Thus the city eliminated the landfill expense, gained 4,372 manhours, saved 3,786 gallons of fuel, and extended the life of the landfill.

AMERICA'S FORESTS MEET DOMESTIC AND WORLD NEEDS FOR WOOD AND PAPER PRODUCTS

October 16-22 is National Forest Products Week established by Congress and proclaimed annually by the President to draw attention to our nation's abundant forest resource and its usefulness.

The vital role of America's forests in serving domestic and world-wide needs for wood and paper products—and in providing environmental and recreational benefits as well—is the theme of National Forest Products Week, October 16-22.

President Reagan called for a nationwide observance to draw attention to the country's abundant forest resource and its contribution to a healthy domestic economy and favorable balance of trade through its great productive value.

"Throughout our history, our Nation's abundant forests have served us in so many vital respects that we sometimes forget this extraordinary renewable natural resource. The growing and harvesting of trees and the work force that turns them into useful products make a valuable contribution to the Nation's economic well-being and to providing homes for our people."

Governors of states throughout the country are expected to follow the White House in issuing proclamations hailing the special week that Congress formally established in 1960.

"We are blessed with forests that can be the most productive in the world if they are managed properly," said John B. Fery, Chairman of the American Forest Institute and Chief Executive Officer of Boise Cascade Corporation.

"The productivity of our forests can serve the wood and paper needs of our country and much of the world and that is the forest products industry's commitment," Fery said.

"At the same time, the forest produces enormous environmental benefits such as watershed and wildlife protection, and recreational opportunities for Americans of all ages who love the outdoors," Fery said.

The Forest Products Industry employs 1.4 million people and annually ships products valued at over $124 billion. Industry owns only 14 percent of the total commercial forest* but provides over 30 percent of the national harvest. Private, nonindustrial landowners hold 58 percent and supply 48 percent of the harvest. Government-owned (or public) lands account for 28 percent of the commercial forest and 22 percent of the harvest.

The Forest Product Industry sponsors the American Tree Farm System, which encourages private landowners to manage their woodland for harvest. More than 45,000 individual landowners participate in the program that currently includes about 85 million acres—the equivalent of the states of New York, New Jersey, Delaware, Pennsylvania and Maryland together.

Last year, one billion trees were planted in the 13 southern states alone as part of the industry's continuing reforestation effort. Industry leaders believe increased productivity on both public and privately-owned forestlands would be in the public interest. It would help supply future domestic demand for wood and paper at reasonable costs to consumers and generate enough growth to help serve world wide wood and paper markets, thereby helping the balance of trade.

**The commercial forest is all forestland, whether owned by individuals, government or the Forest Products Industry, that is capable of and available for growing repeated crops of trees for harvest. It includes land in National Forests but not in National Parks or Wilderness area.*

Reprinted from American Forest Institue News Release.

TIMBER HARVESTING CENTRAL ROCKIES CONFERENCE

Proceedings for the Timber Harvesting in the Central Rockies Conference held January 4-6, 1983 at Colorado State University are now available. The 349 page proceedings cover topics relating to fuelwood supply and demand, forest resource production, harvesting methods and equipment, environmental impacts of harvesting and social relationships to harvesting. The proceedings can be ordered by requesting Publication #XCM-87 from:

Bulletin Room
Cooperative Extensive Service
Colorado State University
Fort Collins, Colorado 80523

Cost of the proceedings is $15.00 plus $1.00 for postage and handling.

CONTRACT LOGGER GERALD DONALD GENERATES INCOME AND HELPS MAINTAIN HIGHWAY RIGHT OF WAYS IN MISSISSIPPI

A recent visitor to the United States from Japan could not get over the amount of land that is consumed and allowed to remain idle in highway medians and shoulders. Because of the tremendous value for land in Japan, every square inch is utilized. We, too, have often wondered why more medians and roadsides are not growing trees. Trees would definitely reduce or eliminate the need to plant, mow and maintain grass and provide an aesthetically pleasing setting for the motorist and give us a valuable resource to help supply material to the ever growing forest products industry. We realize that many states have programs to plant trees, but we see that management and harvest of those forests growing in and around our highways is in many cases non-existent.

But now contract logger, Gerald Donald from Laurel, Mississippi and the State of Mississippi are pioneering a system to harvest, manage and utilize the timber resources owned by the Mississippi State Highway Department. Mr. Donald runs a full scale selective logging and thinning operation on the State of Mississippi Highway Right of Ways. Mr. Donald uses a Morbark Mor-Bell Feller Buncher, a John Deere 440 Grapple Skidder, a Morbark Model 12 Total Chiparvestor and a Morbark Eeger Beever whole tree chipper. All the trees to be removed are marked by Donald and approved for removal by the State. The stands are managed for their best aesthetic value as well as for their potential timber value. As an example, all the Magnolia trees (the State tree) are left with all of the trees removed from around them, and hardwoods are left in preference to softwoods.

Mississippi has a new five cent law, so all trees within thirty feet of the pavement must be cut. Gerald received his contract on a bid basis from the State. He pays the State $8 per cord for all merchantable material, and he must remove everything that is cut including limbs, branches and tops. Sawlogs, veneer and pulpwood are removed and sold to mills in the area, and the small trees, limbs and tops are chipped and sold for fuel.

"We must be very careful in the way we harvest," says Donald. *"We don't want to skin up any remaining trees. That is why the Mor-Bell Feller Buncher works so well in this type of an operation. It is very maneuverable and fast enough to carry the trees out to where they can be skidded. We have a well organized operation and work without any safety problems. We work about seven acres to the mile which yields the State about $1,000 per mile. We do have to work long and narrow strips which you might look at as a disadvantage, but we have very mobile equipment that is easy to move and set up and we don't have to worry about roads. This is the first contract of its kind for the State. I don't think I will ever have to worry about running out of places to work and I only have a contract to work a small portion of the state. I would like to add more crews and work all of the southern part of the State of Mississippi."*

We think Mr. Donald and the State of Mississippi are starting something. The Japanese fellow was right; we are wasting a valuable land resource. At the rate of 7 acres of a shoulder and median per mile, we could grow 5 to 7 tons of fiber per acre per year or 35 to 50 tons per mile of highway per year. In the United States we have an estimated 3.8 million miles of State and Federal Highways, more than half of which are located in forested areas. Thus, we could grow 67 million to 96 million tons of fiber per year along our highways. With the growing use of wood as an energy source, that amount of wood that could be grown on the highway Right of Ways is equivalent to about 144 million barrels of oil. Somebody better tell the DOE.

We all get excited with oil wells, yet we let potential wood energy fields lay idle along our highways. Keep up the good work there in Mississippi. Hopefully, Gerald can keep conjuring up markets for the thinnings, tops and other merchantable material in order to expand all over the State. We will look back in on Gerald in a year or so. If things go as Gerald would like, we just might have to call him J.R. next time around.

UPCOMING SHOWS AND DEMONSTRATIONS

UPCOMING SHOWS

Date	Show	Location
Oct. 7-8	Ohio Forestry Association "Paul Bunyan" Model 30 Total Chiparvestor Mor-Bell Feller Buncher Mortran Portable Chip Screen	Nelsonville, Ohio

DEMONSTRATIONS — TENTATIVELY PLANNED

Demonstration Date	Equipment	General Area
Week of Sept. 26	Super Beever	South Central Oregon
Sept. 26-28	Mor-Bell Feller Buncher Mor-Bell Logger Super Beever	West Point, California
Oct. 1	Mor-Bell Feller Buncher Model 30 Total Chiparvestor	Greenville, North Carolina
First week of Oct.	Super Beever	Washington
Week of Oct. 3	Mor-Bell Feller Buncher	Port Hankesbury Nova Scotia
Oct. 5-7	Model 30 Total Chiparvestor Mor-Bell Rapid Buncher	Coushatta, Louisiana
Oct. 11-13	Model 30 Total Chiparvestor Mor-Bell Rapid Buncher	Saraland, Alabama
Oct. 12-23	Mor-Bell Rapid Buncher	Stark, Florida
Mid Oct.	Super Beever	Idaho & Montana
Oct. 21-22	Mor-Bell Feller Buncher with Rapid Buncher Shear	Land Between The Lakes Kentucky
Oct.	Portable Mortran Screen Georgia-Pacific	Palatka, Florida
Oct.	Portable Mortran Screen Loading Rail-Cars	Cottondale, Florida
Oct.	Portable Mortran Screen	Covington, Virginia
Oct.	Portable Mortran Screen	Savannah, Georgia
Oct.	Mor-Bell Rapid Buncher	Greenville and Spartanburg South Carolina
Oct.	Mor-Bell Rapid Buncher	Columbia, South Carolina
Oct.	Mor-Bell Rapid Buncher	Florence, South Carolina
Oct.	Mor-Bell Rapid Buncher	Charleston, South Carolina

CALL US AT 1-800-621-3540
FOR DETAILS AND DIRECTIONS TO THE DEMONSTRATIONS

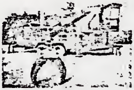
USED EQUIPMENT INVENTORY

TOTAL CHIPARVESTORS

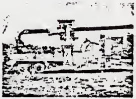
ITEM	MODEL	S/N	ENGINE	CHIPPER	LOADER	SELLING PRIC
1	22	*012	380 Cummins	3-Knife, non-separator	Savage 100 Knuckle Boom	—
2	22	008	38[illegible]ns sold	3-Knife	Slide Boom	—
3	22	*014	12[illegible] sold	3-Knife	Savage 180 Knuckle Boom	115,000.00
4	22	015	12V71 GMC	3-Knife, w/separator	SS-300 Slide Boom	—
5	48	*106	471 Detroit Diesel	2-Knife	Prentice F-BC Knuckle Boom	35,000.00
6	550	079	VT[illegible]mins sold	—	Slide Boom Loader	69,500.00
7	550	*098	VT[illegible]mins sold	2-Knife, w/separator	Slide Boom Loader	90,500.00
8	Precision	C1389L-103	60[illegible]mins sold	4-Knife	No loader	—
9	20-Demo	*138	VT-903	2-Knife, w/separator	Knuckle Boom Loader	116,000.00
10	22	*011	380 Cummins	3-Knife, w/separator	Savage 180 Knuckle Boom Loader	100,000.00
11	22	1161	380 Cummins	3-Knife, non-separator	Slide Boom Loader	66,000.00
12	22	*017	380 Cummins	3-Knife, non-separator	Slide Boom Loader	82,500.00
13	22	013	8V71 GMC	2-Knife, w/separator	Savage 180 Knuckle Boom Loader	110,000.00
14	DL60	*Trelan	8V71 GMC	2-Knife, w/separator	No loader	45,000.00
15	22	1450	600 Cummins	—	Slide Boom Loader, No separator	125,000.00
16	22	1240	12V71 GMC	2-Knife, non-separator	Barko 160	87,000.00
17	22	1417	600K Cummins	3-Knife, w/separator	Slide Boom Loader	139,000.00
18	22	1141	600K Cummins	3-Knife, non-separator	Slide Boom Loader	—
19	22	016	600K Cummins	3-Knife, non-separator	Slide Boom Loader	150,000.00
20	22	1545	600K Cummins	3-Knife, w/separator	Slide Boom Loader	—
21	Super Beever	101	Avco	3-⅓ Knives	Knuckle Boom Loader	32,000.00
22	Super Beever	102	Perkins	2-½ Knives	Knuckle Boom Loader	35,000.00
23	Super Beever	*103	V-504 Cummins	4-½ Knives	Knuckle Boom	40,000.00

NOTE: Machines without prices are in the process of being rebuilt. Prices will be established after rebuild is completed.
***Designates that this is a factory reconditioned unit.**

MODEL 22



MODEL 20 KNUCKLE BOOM



MODEL 22 S/N 1161

SUPER BEEVER

CHIPPERS

ITEM	MODEL	S/N	DESCRIPTION	SELLING PRICE
1	48"	690417	Bush, Drop Feed, Top Discharge, 6-Knife	$ 8,900.00
2	75"	—	Experimental, Multi-Knife, disc only, non-separator, for 3/8" bedding chips	3,000.00
3	75"	128	6" Disc, 3-Knife with Discharge Spout	—
4	75"	192	Precision, 4-Knife, Horizontal Feed, End Discharge	15,000.00
5	75"	214	2-Knife, Horizontal Feed, End Discharge	17,500.00
6	75"	588	3-Knife, Horizontal Feed, End Discharge	17,500.00
7	84"	C1064	Precision, 3-Knife, Horizontal Feed, End Discharge	18,000.00
8	75"	436	3-Knife 75" stationary horizontal feed, bottom discharge Chipper with 400-HP US electric motor and 400 volt transformer starter with drive	34,900.00
9	Shredder	—	New Lamb 23" x 24" Wood Shredder, 100 HP Electric	19,800.00

N. W. INFEED

632-20' INFEED

TROUGH TYPE CONVEYOR

CONVEYORS

ITEM	S/N	DESCRIPTION	SELLING PRICE
1	817	632 — 20' Infeed, Tilti sold Chain, Hydraulic Drive with power	$ 2,400.00
2	—	16' NW Infeed, With infeed kicker, Without drive	3,450.00
3	2490	20' C-Series Hourglass Roll Case, With 4-arm kicker, Without drive, 22" Rolls	3,950.00
4	2745	20' C-Series Hourglass Roll Case, No kickers, Without drive, 22" Rolls	3,650.00
5	2013	36' x 8" Waste Conve sold hain, With rubber flites, Hydraulic Drive without power	1,700.00
6	82-3104	15' x 8" Waste Conve sold hain, With rubber flites, Hydraulic Drive with power	1,000.00
7	3090	50' x 20" Flat Top Chip Conveyor, C-188 Chain, Without drive, No legs	4,000.00
8	3101	20' x 48" Chip Conveyor, C-188 Chain, With wooden flites, Hydraulic Drive without power, No legs	3,500.00
9	82-007	40' x 30" Belt Conveyor, No drive, Conveyor raises at 30 degree angle beginning 9' from idler end	5,000.00
10	52-1865	24' x 14" TTC, 6110 Chain, No drive, Height of sides from bed 13", F-stop 40" from drive end	3,400.00
11	82-3105	20' x 14" SPECIAL TTC, 6110 Chain, Hydraulic Drive without power, 3/8" x 23" high sides, No legs	3,000.00
		NOTE: Items 12 and 13 will be sold together only.	
12	1028	Model 45 Scoop-Roveyor, 45' x 24" top traveling conveyor, 75 HP pump stand, cab with heater	—
13	7002	Morbark 70' Radial Stacking Conveyor, 24" wide, C188 steel chain with wooden flites, swing 270° hydraulic drive - Price for both the Scoop-Roveyor and Stacking Conveyor	55,000.00

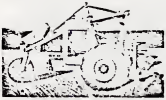
EEGER BEEVERS

ITEM	MODEL	S/N	DESCRIPTION	SELLING PRICE
1	Curb Feed	295	2-Knife ¾", Wisconsin Engine	—
2	Curb Feed	107	2-Knife ¾", Wisconsin Engine	—

SKIDDERS

ITEM	MODEL	S/N	DESCRIPTION	SELLING PRICE
1	Mountain Logger	74125	ML-100 Cable Skidder, 18.4" x 26" tires, 453 Detroit diesel, Clark reversing 4-speed power shift transmission, no-spin front and rear, root rake, 32,000 lbs. Gearmatic winch	$38,250.00
2	Mountain Logger	74164	New ML-100 Cable Skidder, 18.4" x 26" tires, 453 Detroit diesel, Clark reversing 4-speed power shift transmission, no-spin front and rear, 32,000 lbs. Gearmatic winch	42,390.00
3	Mountain Logger	74174	New ML-130 Cable Skidder, 23.1" x 26" tires, 453 Detroit diesel, Clark reversing 4-speed power shift transmission, no-spin front and rear, 32,000 lbs. Gearmatic winch	49,050.00
4	Hydro-Mac	42781	Model 20C sold er Loader, diesel engine, 12.00 x 16.5 tires, tracs and buckets available	10,000.00
5	Hydro-Mac	42782	Model 20C Skid Steer Loader, diesel engine, 12.00 x 16.5 tires, tracs and buckets available	10,000.00
6	Hydro-Mac	42783	Model 20C Skid Steer Loader, diesel engine, 12.00 x 16.5 tires, tracs and buckets available	10,000.00
7	John Deere	—	Model 540B Grapple Skidder, 18.4 x 34 tires, 1980 with new rubber	48,000.00

MOR-BELL LOGGER



MOR-BELL
FELLER BUNCHER

MOR-BELL LOGGERS

ITEM	S/N	DESCRIPTION	SELLING PRICE
1	MB-11, Rebuilt MK 3.5	Mor-Bell Logger with Grapple sold	$41,800.00
2	MB-13	Mor-Bell Logger with Grapple	40,550.00
3	MB-17	Mor-Bell Logger with Grapple	—
4	MB-22	Mor-Bell Logger with Grapple	41,000.00
5	MB-31	Mor-Bell Logger with Grapple sold	—
8	MB-35	Mor-Bell Logger with Grapple	—
7	MBS-114	Mor-Bell Feller Buncher, 13" Shear, 730 hrs.	44,750.00
8	MB-5, Rebuilt MK 3.5	Mor-Bell Logger with Crosscut Grapple	46,265.00
9	MBS-111	Mor-Bell Feller Buncher with air conditioner, factory demonstrator	43,500.00
10	MBS-124	Mor-Bell Feller Buncher, 13" Shear, 370 hrs.	46,500.00
11	MBS-144	Mor-Bell Feller Buncher, 13" Shear	49,500.00
12	MBS-134	Mor-Bell Feller Buncher, 13" Shear, 60 hrs.	49,000.00
13	MBS-92	Mor-Bell Feller Buncher, Rapid Buncher	52,000.00

COMPLETE SAWMILL FOR SALE

Morbark Medium Duty Live Deck 20' Long, S/N 2044, 3-strand with 3-arm stop and loader

Morbark 636 Debarker, S/N 339, 25' trough type infeed conveyor, 25' trough type outfeed conveyor, one set of manually operated 3-arm kickers, 100-HP T-frame motor to operate the cutterhead, 30-HP T-frame motor to operate hydraulic system

Morbark Mor-Pac Mill, S/N 2998, log stop and loader, chain bar log turner, automatic carriage with 6-position push button setworks, 4" tapers on each knee, 36" opening, 40-HP 20" diameter 2-saw vertical edger with push button setworks, saw husk with 54", 42-tooth 7-8 gauge "F" style blade

Morbark Heavy Duty Green Chain, S/N 1949, 20' long, 3-strand

Morbark Heavy Duty Green Chain, S/N 1950, 50' long, 3-strand

Morbark Vibrating Conveyor, S/N 033, 20' x 21"

Morbark 586 Series "E" Chip Pac, S/N 598, with Morbark 58", 6-knife, horizontal feed chipper

Morbark automatic One Man End Trimmer, S/N 2953

Frick 7-saw Bull Edger size #641, S/N 241—Kat Guard Air Compressor, S/N 28729—Patz Conveyor System complete with 30' Upright Conveyor, S/N C1661811479—Extra saws for both the Bull Edger and the Sawmill—Compelte wiring with all disconnects

METAL BUILDING PLUS EIGHTY (80) ACRES OF LAND NEAR INTERNATIONAL FALLS, MN.

PRICE FOR THE COMPLETE MILL, LAND AND BUILDING $250,000.00

PORTABLE SAWMILL FOR SALE

1981 Utilizer Portable Sawmill. Mount on tractor 3 point hitch P.T.O. drive, 3 head block reseater, clock face figure board, sawdust blower, 2-insert tooth blade, 16'6" log capacity

1981 Utilizer Edger. Mounted on two wheel trailer, 18-HP Kohler Industrial engine. Can be towed behind sawmill. Complete mill set up time one hour

1973 Dodge semi-tractor. 413 gas engine, single axle, 5-speed transmission, 2 speed axle, 40' tandem implement trailer

PRICE $15,000.00

MOR-PAC MILLS FOR SALE

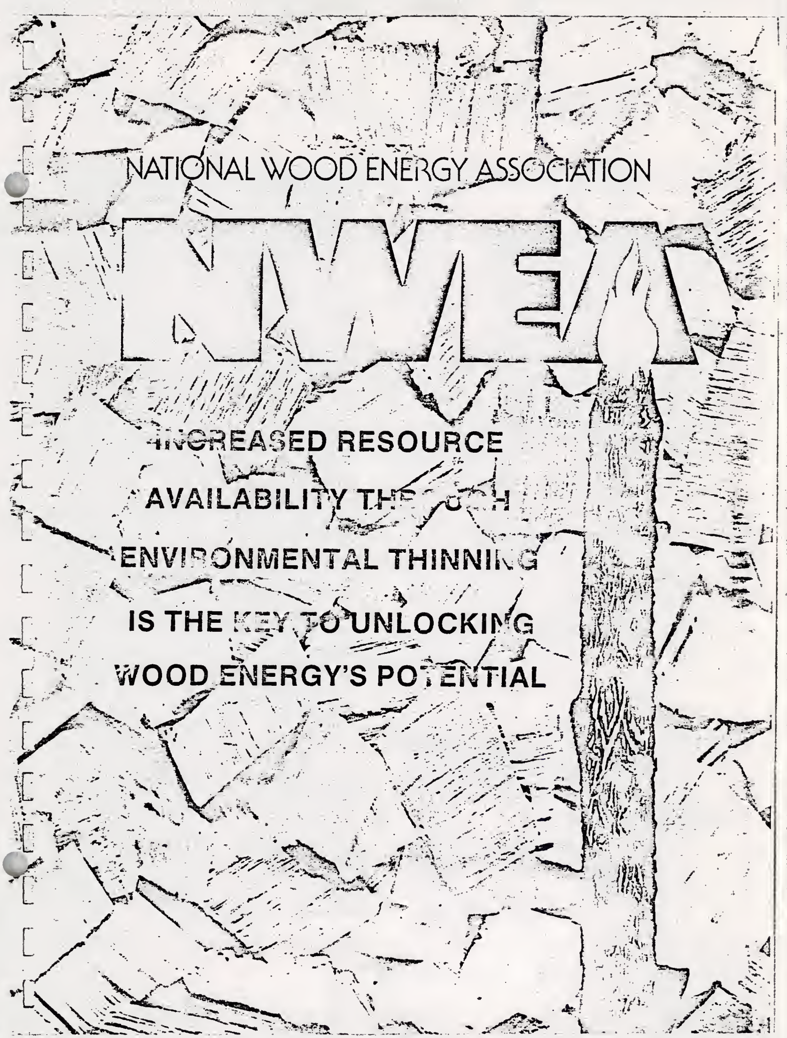
Morbark Mor-Pac Mill with Vertical Edger and Log Turner

Price $40,000.00

EDGER FOR SALE

36" x 4" Prescott Edger, 4 saw

Price $22,000.00

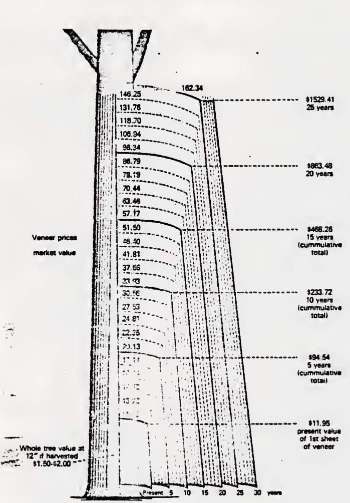


NATIONAL WOOD ENERGY ASSOCIATION

NWEA

INCREASED RESOURCE AVAILABILITY THROUGH ENVIRONMENTAL THINNING IS THE KEY TO UNLOCKING WOOD ENERGY'S POTENTIAL

BENEFITS OF ENVIRONMENTAL THINNING



It is important that landowners understand the ever increasing value of veneer quality fiber over the period of years as the tree moves toward maturity. With proper thinning, a 30 year old tree with a base diameter of 12 to 14 inches will continue to add mass in height and width. Each annual ring or layer of fiber is about 3/8" thick, but each successive sheet of veneer is that much larger than the preceding one as the years go by. As a result the mass of the rings increase by approximately 11% annually, as does the value for that greater mass. Just as dollars left in a savings account will compound interest, the value of the veneer fiber will compound annually so that the first ring, worth about $12 one year after the initial thinning, will increase by over 15 times to over $160 in 25 years. By adding the value of each of the new fiber rings and compounding annually, the total additional veneer fiber can grow to up to $1,500 over that 25 year period. Of course, not every tree will have that much economic potential, but the increased mass of quality timber for future saw log material will also greatly increase the value of the woodlot investment.

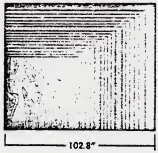
The chart on the opposite page shows a hypothetical, yet realistic example of the increase in value and accelerated growth in typical forested acreage as a result of environmental thinning. The graph shows the dramatic increase in the per acre dollar value and the increased weight over a 60 year period with successive thinning cycles at 10 year intervals. Notice that the value of the tonnage removed has also increased as time goes by due to greater quantity and quality of the entire stand. From 1983 with 100 tons valued at $320 ($240 standing plus $80 removed) to the year 2033 with 200 tons standing valued at $1,820 (and an additional $1,530 value removed over the period) it can be seen that the mass has doubled and the economic value increased over 10 times.

Of course timber value, inflation, geographical area and the characteristics of the individual woodlot all act in changing specific projections over time, however the principle of added weight gain and increased quality through environmental thinning can be expected to show similar results in most any situation.

The bottom chart shows the effect on the same hypothetical woodlot using conventional harvesting practices. Value is only received in 1983 and 40 years later in 2033 when the stand is clear-cut again. The total value after two cycles is only $640 compared to the increasing value and greater mass achieved with environmental thinning.

25 YEARS
AFTER THINNING

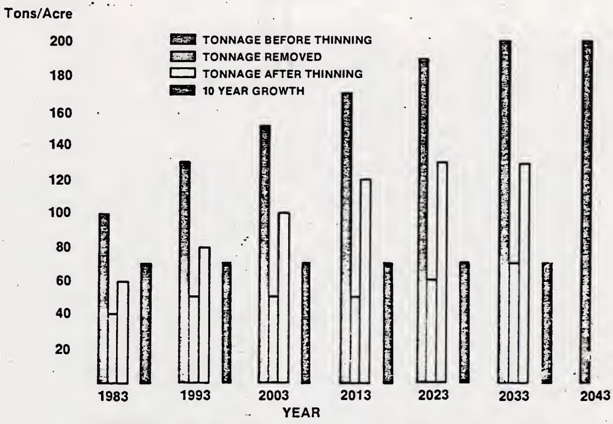
32 3/4" DIAMETER



FIRST VENEER LAYER $162.34
TOTAL VALUE $1,529.41

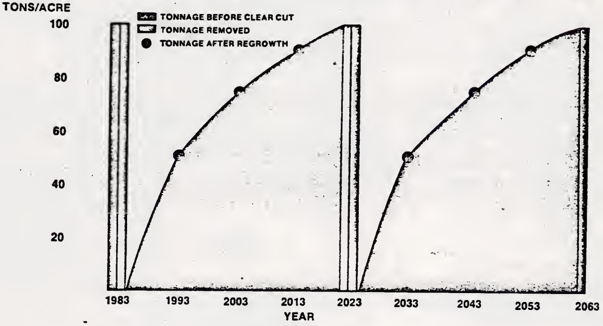
VALUE AND MASS USING ENVIRONMENTAL THINNING

DOLLAR VALUE:						
Per Acre	$240	$480	$800	$1,200	$1,560	$1,820
Removed	80	150	200	250	360	490
Total Removed	80	230	430	680	1,040	1,530
Year	1983	1993	2003	2013	2023	2033



VALUE AND MASS USING CONVENTIONAL CLEAR-CUT HARVESTING

DOLLAR VALUE:									
Per Acre	$ 0	$ 50	$130	$200	$ 0	$ 50	$130	$200	$320
Removed	320	0	0	0	320	0	0	0	0
Total Removed	320	320	320	320	640	640	640	640	640
Year	1983	1993	2003	2013	2023	2033	2043	2053	2063



BENEFITS OF ENVIRONMENTAL THINNING

To illustrate Environmental Thinning, we have marked 8 high quality trees in a 1/10 acre test area of an overcrowded hardwood stand.

After Environmental Thinning, those 8 high quality trees now have proper basal area for accelerated growth. Five tons of junk wood are piled in bunches for removal.

Environmental Thinning is a system of selectively removing this unwanted fiber and leaving the best trees. This enables our forest lands to produce 3 to 4 times the amount of fiber produced without thinning. Instead of using traditional "clear-cut" harvesting techniques or leaving nature to manage her own timber lands, the landowner will enjoy the greatest economic return through environmental thinning.

Pictured above is a representative sample of a hardwood stand in need of thinning. The trees with the highest potential have been marked. Because those future veneer trees require approximately one foot of basal area for every inch of diameter, the other trees, consisting of malformed, overcrowded and dead material will be selectively cut and ultimately chipped and screened to provide a source of furnish to the Pulp and Paper Industry or for fuel in wood-fired energy systems. Above is the same hardwood stand with the marked trees now provided with ample space to increase in size and value. The junk wood has been piled in bunches so that it can be removed quickly and easily. Although this thinning operation took place on about 1/10 of an acre, the piled fiber or about 5 tons, demonstrates the vast potential that proper environmental thinning can produce. By leaving potential sawlog or veneer trees and removing about 50 tons to the acre, the landowner can realize anywhere from a 50 to 100% increase in the value of his land as a result of the thinning. In addition to receiving value for the removed fiber, the mass of the standing timber that will greatly increase if proper thinning is maintained, will represent a huge increase in the economic value of the veneer trees.

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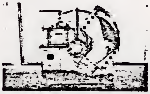
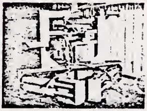
DEBARKERS, CHIP-PACS, DECKS AND SCREENS

ITEM	MODEL	S/N	DESCRIPTION	SELLING PRICE
1	EM-16 Debarker	—	—	—
2	FM-16 Debarker	667	—	—
3	1981 27" Brunnette	—	Ring Debarker with 60' 'Hourglass' infeed and 25' outfeed with 50—HP drive on ring and 40-HP drive for infeed and outfeed	57,000.00
4	26" Forano	—	Ring Debarker, New trough type infeed, electrical panel	13,300.00
5	636 Debarker	—	25' inf sold utfeed	22,000.00
6	Mortran Screen	81-001 81-002 81-003	Stationary Screen, 3-Section, 75 ton per hour capacity	29,500.00
7	Mortran Screen	81-015	Stationary Screen, 3-Stage overs screening system, 90 tons per hour capacity	12,000.00
8	Mortran Screen	81-017	Portable Screen, Complete with surge bin	57,500.00
9	Mortran Screen	81-027	Portable Screen	75,000.00
10	Mortran Screen	82-032	Portable Screen	82,000.00
11	Stac-Trac	257	25-HP Onan, Gasoline Engine, 30' Track	14,000.00
12	Blower	371	10-HP, 10' blow pipe and base	—
13	58" Chip-Pac	599	"E", 6-Knife, horizontal feed, without power	18,000.00
14	48" Chip-Pac	—	—sold	—
15	632 Portable	997	GMC 471 Diesel, 16' infeed with pintle hitch, excellent conditon	20,950.00
16	PS-8	137	Portable hydraulic powered top yoke, PTO, Hand set infeed shoe	8,000.00
17	C-12 Debarker	612	—	19,500.00
18	636 Debarker	608	Center Section Only	—

PRENTICE H LOADER

15" SHEAR


BUSH CHIPPER


20" SHEAR

SHEARS AND LOADERS

ITEM	MODEL	S/N	DESCRIPTION	SELLING PRICE
1	10"	10-5	Feller Buncher Shear	—
2	15"	1413	Feller Buncher Shear	—
3	20"	2217	Additional accumulating finger, 2 1/2" Pins	10,000.00
4	Lucky Loader	31775535	Model sold C; NEW 353 GMC Aux. power, 36" log grapple, live heel	20,000.00
5	MT Carriage	149	Heavy Duty Mor-Trac Carriage, 4-wheel hydraulic drive powered from loader	17,950.00
6	Prentice H	15315-73101	NEW cab and door, all cylinders checked out, No grapple	8,700.00
7	Mor-Lift	1009	Loader	—
8	Barko	—	140 Pulpwood and log loader, with 453 Detroit diesel, includes 48" copeland slasher all mounted on 1974 Ford F600	24,750.00
9	24" Drott	—	Rotary auger feller buncher head, with parts	19,000.00
10	521 Hydro Ax	—	1979 with Morbark Model 15" Feller Buncher with 6" cylinder, 8' Rotary Brush Hog attachment, has 40 hrs. use, carrier has approx. 2,000 hrs.	55,000.00

EXPERIMENTAL AND MISCELLANEOUS

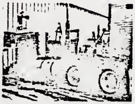
ITEM	MODEL	S/N	DESCRIPTION	SELLING PRICE
1	Pole Assistor	—	Used for debarker or pole peeler	—
2	Bark Blower	—	PS-8 style	—
3	Blower	—	36" Phelps, With 20-HP motor	500.00
4	Pump Stand	—	30 gallon tank, 10-HP, one-section gear pump, DF4 valve	1,500.00
5	Pump Stand Base	379	100 gallon, can mount up to 4 individual double pumps	—
6	Pump Stand Base	—	90 gallon, can mount 2 individual double pumps	—
7	Chip Thrower	020	30-HP, can be hydraulic or electric, with short power, hopper, swivel chain, motor, spout	4,900.00
8	Thrower	023	30-HP, can be hydraulic or electric, short power, hopper, swivel chain, motor, spout	—
9	Chip Thrower	026	Hydraulic, 10,000 Char-Lynn, conveyor mount, swivel discharge, short swivel motor, spout and tilt cylinders	—
10	Thrower	027	30-HP, Swivel discharge, short power, hopper, spout, swivel chain and motor	—
11	Chip Thrower	028	Hydraulic, 10,000 Char-Lynn, swivel base	—
12	Chip Thrower	029	48", Model 22 type transition and discharge spout	—
13	Chip Thrower	030	50", Model 22 type transition and discharge spout	—
14	471 Detroit Diesel	—	With radiator, no hood or side curtains, LH, 100-HP continues 133-HP gross	6,950.00

471 DETROIT DIESEL

MOTOR BASE

PUMP STAND

IHF2070


MACK GLIDER

CHEVY C-10

TRUCKS

ITEM	MODEL	S/N	DESCRIPTION	SELLING PRICE
1	Mack Glider	78WSK700642	1978, V-8, 13-speed, non-sleeper, tandem axle Michigan special	$20,000.00
2	Mack Tractor	MICH 77732	1977, V-8, 13-speed, non-sleeper, tandem axle Michigan special	17,000.00
3	Mack Tractor	F5797LST22430	1974, V-8, 13-speed, tandem axle Michigan special	10,000.00
4	IHF2070	75797QGB23399	1974, Quad Axle, 290 Cummins with dual air axle, lift and Prentice loader	21,000.00
5	Chev C-60	CE63P814934	1969, 366 V-8, 4-speed transmission, complete parts and service van	4,500.00

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QTY.	KNIFE NO.	MACHINE	SIZE	SALE PRICE
37	1-156B	78" Black Clawson Chipper	24 x 6 x 1/2	$ 52.00
41	1-183	112" Sumnxr Hxlf Chipper	14-1/2 x 5 x 1/2	26.80
206	10-102	30" Morbark Hxlf Counter	15-7/8 x 2-7/8 x 3/8	15.00
22	11-108	84" Fulghum Chipper	26-1/2 x 4-3/4 x 1/2	47.65
22	2-205	36" CM&E Chipper	9 x 3 x 1/4	10.45
23	2-225T	48" Norman Chipper	16 x 4-1/2 x 3/8	21.00
41	2-246R	Swecan 6" Bent Knife	10-3/16 x 8-7/16 x 3/8	34.75
12	3-312	Kockums	2 x 5-3/4 x 7/6	25.25
7	4-400	Jackson Chipper	12-1/2 x 6 x 1-1/4	108.00
45	4-402	Jackson Chipper	14 x 6 x 5/6	55.00
13	4-403A	Jackson Chipper	33 x 6 x 1-1/4	240.00
44	5-509A	56" Soderhamn Half Chipper	8-13/16 x 6 x 7/8	46.50
12	5-523B	75" Soderhamn	23 x 5 x 1/2	38.50
216	5-525	75" Sodxrhamn Half Counter	11-1/2 x 2-7/8 x 3/8	12.50
38	5-525A	76" Soderhamn Count.	23 x 2-7/8 x 3/8	16.50
12	5-528	Soderhamn Chipper	14-3/8 x 6 x 5/8	35.00
23	5-560	75" Forano Counter	23-1/2 x 2-3/4 x 3/8	24.25
13	6-603S	Hxnsel Half Chipper	11-1/2 x 5 x 1/2	16.00
134	6-607D	45" Nicholson Chip.	14-3/4 x 4 x 3/6	25.00
23	7-720	Chip King #60 Count.	20 x 3-3/4 x 7/16	33.50
10	8-1107	Newland Chopper 16" Glass Fiber Chopper	15-1/2 x 5 x 3/4	40.95
106	8-1116A	Adco West Edger	1-9/16 x 3-1/8 x 3/4	16.00
56	8-1116CR	Adco West Duckbill	1-9/16 x 3-1/2 x 1	15.00
17	8-1213	Adco West Top Chip Head Knife	2.8 x 4-11/32 x 1.56	26.00
11	8-1383SQ	Comact square slot	14-3/8 x 5-3/6 x 5/6	60.00
933	8-822L	Arasmith Lily Pad	1-3/4 x 4 x 1/2	7.00
207	8-822C	Arasmith Lily Pxd	1-5/8 x 4 x 7/16	7.00
122	8-22E	Arasmith Lily Pad	1-3/4 x 4 x 1/2	7.00
39	8-822V	Arasmith Lily Pad	2 x 4 x 1/2	7.00
128	8-836A	Pallman PZ-6	7.04 x 2.266 x .316	6.00
15	8-854	Carthagx Chipper	16 x 3-3/4 x 11/16	40.00
6	8-857H	Veneer Lathe Knife	54 x 7-1/2 x 5/8	125.00
3	8-880	Filer & Stowell-2" Counter	1-29/32 x 5-3/4 x 3/8	15.00
160	8-899B	Bexver Canter	1-1/6 x 3-1/4 x 21/64	10.00
96	8-906A	Nicholson Half Counter	14-5/16 x 2-5/8 x 3/6	14.00
25	8-830L	26" Nicholson V Drum	10-1/4 x 5-5/8 x 11/16	57.50
30	8-930R	26" Nicholson V Drum	10-1/4 x 5-5/8 x 11/16	57.50
261	8-671A	10" Cen Car "V" Head Counter Knife	10 x 3-1/2 x 3/6	54.50
28	8-980L2	Can Car Edger	4-3/4 x 7-3/8 x 5/8	23.00
28	8-980L4	Can Cer Edger	8-11/16 x 8-1/2 x 5/6	32.00
26	6-680R2	Can Car Edger	4-3/4 x 7-3/8 x 6/8	23.00
12	8-991R3	CN6 Model 5000	8-13/16 x 6.129 x .25	32.25
36	8-993	50" Can Car	14 x 4 x 5/6	22.35
25	8-935S	Hog Knife	8-1/2 x 8-1/2 x 5/8	24.75
45	AA-1L	J.D. Vence, Fulghum Chipper Knife	7-5/8 x 4 x 3/6	15.25
16	MKC-456	84" Soderhamn	28 x 6 x 1/2	85.75
90	MKC-463	Carthage	31 x 5 x 1/2	46.25
29	MKC-467	Carthage	28 x 5-3/4 x 5/8	68.00
54	MKC-570R	Adco West	3 x 4-13/16 x 3/4	11.35
55	MKC-571L	Adco West	3 x 4-13/16 x 3/4	11.35
16	MKC-73A	112" Carthage	27 x 6 x 1/2	45.75
16	MKC-75K	110" Murray	31 x 6 x 5/8	65.00
105	CH-308	48" Soderhamn	14-3/8 x 5-3/4 x 5/8	39.50
32	MKC-203H	84" Fulghum Half Chipper	13-1/4 x 4-3/4 x 1/2	21.50
12	MKC-204B	75" Fulghum Chipper	23-1/2 x 4-3/4 x 1/2	39.25
61	MKC-242	75" Fulghum Chipper	23-1/2 x 6 x 1/2	42.25
62	MKC-242A	75" Fulghum Chipper	23-1/2 x 4-3/4 x 1/2	39.00
47	MKC-276	Bush Chip Gainer	6 x 3 x 1/2	17.00
15	MKC-7A	Carthagx	14 x 5-1/4 x 3/4	48.45
25	MKC-81	41" Jackson Chipper	14 x 6 x 5/8	42.00
24	MKC-99	60" Bush Chipper	16 x 4 x 1/2	24.50
106	MKCW-505	Carthagx Knifx B-4561	27 x 8-1/2 x 1/2	57.75
13	11-101L	J.A. Vxnce Fulghum Wear Plxte	7-7/8 x 2-1/2 x 1/6	7.16
10	11-101R	J.A. Vxnce Fulghum Wxxr Plxtx	7-7/6 x 2-1/2 x 1/8	7.16
16	11-114	36" Fulghum Counter	7 x 2-1/4 x .312	6.25
17	3-301K	60" Bush Chipper	16 x 4 x 3/6	23.50
55	5-507A	66" Soderhamn Countxr	21-1/2 x 2-1/8 x 3/6	17.50
21	5-526	75" Sodxrhamn Counter	11-3/4 x 2-3/4 x 3/8	13.00
10	5-556	66" Soderhamn Halt Counter	10-3/4 x 2 x 3/6	6.65
36	5-567	Soderhemn Chipper	10-3/4 x 4.475 x 1/2	18.90

MICHIGAN KNIFE COMPANY CONTINUED

QTY.	KNIFE NO.	MACHINE	SIZE	SALE PRICE
28	7-700	48" Sxlxm Chipper	15 x 5-1/2 x 3/8	25.00
40	7-711	48" Sxlem Counter	18 x 3-3/4 x 3/8	17.50
12	7-714	80" Salem Chipper	20 x 5 x 1/2	33.00
18	8-1085	Brxdson Disc Chipper	22 x 5-1/2 x 3/8	25.50
10	8-1088	Bradson Disc Chipper	15 x 4-1/2 x 3/8	19.50
18	8-1118	Adco Wxst Chipper	1-18/32 x 3-1/8 x 3/4	10.00
125	8-1118S	Adco Wxst Edgxr	1-21/32 x 3-1/8 x 3/4	10.00
588	8-1137	Lily Pxd Clxmp	1-1/2 x 2 x 5/8	6.50
8	8-1138B	Garrett Weldco Slotted Knife	4 x 5-1/2 x 1/2	11.55
8	8-1188	66" Hansel Counter	19-1/2 x 2-1/2 x 3/8	12.00
15	8-1285A	Impellxr Wxxr Plxtx	17-9/32 x 1.496 x .433	10.00
10	8-1288E	#5 Pellman Pulvxrizer	9-1/18 x 1-3/18 x .240	4.65
24	8-1297	Plotted Plxner Knifx	18 x 4 x 1/2	18.50
18	8-1320L	93" CAE Flxker	13-3/4 x 3 5/18	15.00
52	8-1320R	93" CAE Flxker	13-3/4 x 3 x 5/18	15.00
11	6-1372	Roll Splitting Knife	36 x 3 x 3/8	40.00
51	8-1374	No Slot Chipper	15-1/2 x 3-1/2 x 7/16	18.00
10	8-1430	Chipper Knife Clxmp	11-3/4 x 8-15/18 x 1	46.00
18	8-1452	132" Nicholson Chipper	23 x 6-3/8 x 1/2	44.00
12	8-1499	69" CAE Chipper	22 x 4-13/18 x 3/8	27.50
38	8-1509	Carthage Chipper-Kxyhole Bbt.	20-1/2 x 8-1/2 x 3/4	58.00
28	8-1546	CAE Counter	18 x 2-3/8 x 3/8	11.00
36	8-1608	Forano Wing Knife	7-1/2 x 4-3/4 x 3/8	15.75
23	8-1700A	CAE Flxker Counter	27-1/2 x 2 x 5/18	19.70
7	8-1924	CAE Log Chipper	12-25/32 x 7-7/8 x 13/18	49.85
12	8-822AS	Arasmith Lily Pad Knife	4-1/18 x 1-3/4 x 1/2	7.35
28	8-822G	Arasmith Lily Pxd Knifx	2-1/4 x 3-7/8 x .475	7.00
7	8-840A	Pellmxn PZ12	7.042 x 2.85 x .187	6.30
4	8-857KB	Veneer Knife-Keyhole Bbt.	54 x 7-1/2 x 7/18	108.00
22	8-873AL	Adco West Lily Pxd	1-3/4 x 3-1/4 x 1/2	7.95
65	8-873AR	Adco West Lily Pad	1-3/4 x 3-1/4 x 1/2	7.85
8	8-874A	Carothers Feeder	25 x 4 x 3/8	24.00
29	8-884A	Clipper	65 x 5-1/2 x 1/2	105.00
8	8-810	Polx Peeler	10-5/8 x 2 x 1/4	6.25
21	8-817	L-2 Nicholson	15-1/2 x 2-15/18 x .187	12.00
26	8-981L1	Can Car Side Edgxr	4-3/4 x 8-3/4 x 1/4	11.15
44	8-881R	Can Car Counter	4-1/8 x 8-1/2 x 1/4	10.00
12	8-991L3	Can Car Counter	8-13/18 x 8.128 x .25	35.00
12	8-991R3	Can Car Counter	6-13/18 x 9.129 x .25	35.00
10	8-810D	Sumner Hog	8-7/8 x 7 x 1/2	9.75
17	8-17AR	Veneer Hog	4 x 6-3/4 x 3/4	5.00
14	8-824S	M&M Hog	8-1/8 x 10-1/4 x 5/8	17.65
60	9-939	M&M Hog	8 x 7-1/2 x 1/2	8.25
23	9-972	Sodxrhxmn Hog	7-7/8 x 5.905 x .472	8.25
30	8-983	Hog Knife	3 x 13-1/2 x 3/4	8.40
17	AN-103L	M&M Fxbricator	7-1/2 x 5 x 1/2	20.75
18	AN-103R	M&M Fxbricator	7-1/2 x 5 x 1/2	20.75
18	KN-0123LS	M&M Fxbricxtor Cant	4 x 7-1/4 x 1/2	20.00
29	KN-0123RS	M&M Fxbricator Cant	4 x 7-1/4 x 1/2	20.00
7	MKB-13A	Fitchburg Brush Chipper	12 x 2-5/8 x 5/18	9.45
8	MKB-7S	Brush Chipper	4-1/4 x 2-3/8 x .500	7.50
8	MKC-117	30" Carthage Chipper	30 x 5 x 5/8	55.00
7	MKC-2	47" Carthage Chipper	11 x 5-1/2 x 3/4	35.00
6	MKC-212C	60" Fulghum Chipper	18-1/4 x 4 x 3/8	24.00
18	MKC-456	84" Soderhamn Chipper	28 x 6 x 1/2	40.75
90	MKC-493	Carthage Norman Chipper	31 x 5 x 1/2	35.00
29	MKC-487	Carthage Chipper	28 x 5-3/4 x 5/8	58.00
24	MKC-515A	60" Carthxge Chipper	27 x 8 x .688	71.50
18	MKC-75K	110" Murray Chipper	31 x 8 x 5/8	67.75
4	MKCW-18	Carthagx Normxn Chipper	21 x 6-1/2 x 1/2	41.65
4	MKCW-488	Carthage Chipper	24 x 8-1/2 x 5/8	56.35
6	MKK-237A	Black Clxwson Counter	20 x 2-1/2 x 3/8	14.15
8	MKK-273B	66" Fulghum Countxr	18-1/4 x 2-7/8 x 3/8	13.50
43	MKK-350	48" Fulghum Counter	14-1/8 x 2-1/8 x 3/8	14.00
8	MKKW-178	66" Soderhamn Counter	21-1/2 x 2-1/4 x 3/8	18.60
30	MKKW-78	60" Hansel Counter	18 x 2-1/2 x 3/8	15.00
		HARD SURFACED ANVILS		
2	HS-38"	Soderhamn Vertical	8-5/8 x 3 x 1	59.50
1	HS-48	Soderhamn	13-1/2 x 2-3/4 x 1-3/8	66.35
10	HS-50	CM&E Horizontal	6-3/4 x 2 x 1/2	43.10
2	HS-50	CM&E Vertical	9 x 2 x 1/2	42.85
3	HS-58	Precision Spout	13 x 3 x .715	65.80
8	HS-60	Fulghum Horizontal	18-1/32 x 3 x 1/2	78.00
1	HS-64	Beloit Vertical	18 x 3 x 1	118.85
3	HS-66	CM&E Horizontal	18-3/8 x 2-7/16 x 5/8	108.75
1	HS-66	Kockums	21 x 5 x 1	152.85
2	HS-68	Precixion Vertical	18-1/2 x 5 x 1-1/2	172.35
2	HS-75	Bush Vertical	22-1/8 x 5 x 1-1/2	208.65
2	HS-96	Buxh	28-1/4 x 5 x 1-1/2	263.00
2	HS-24	Jackxon	31 x 4-3/4 x .9375	177.15
4	HS-48L	Buxh Spout	15 x 2-3/8 x 3/4	78.95
1	HS-60	Bush Metallurgical	11-3/4 x 5 x 1-1/2	118.50

PARTS SALES

Each month through the use of the "MORBARK FLYER" we will offer Parts at considerable savings to our customers. These parts will be categorized in the following ways: "Monthly Sale Items", "Used and/or Rebuilt Parts", and "Excess and/or slow moving parts we have available in this issue.

Each monthly Flyer will be updated to reflect changes in the status of each part concerning prices, additions and deletions.

As outlined on page 143 of our 1983 Equipment Catalog, additional discounts are available with some quantity and volume orders.

Specially priced parts listed in this flyer are subject to prior sales.

NEW HOURS

Effective September 1, 1983

Monday-Friday: 7:00 a.m.—7:00 p.m.
Saturday: 9:00 a.m.—1:00 p.m.
Sunday: Closed

Phone: 1-800-621-3540

MORBARK PARTS DISCOUNT PROGRAMS

Besides our normal WHOLESALE prices, we offer a volume discount as outlined here. If you would refer to page 378 of our 1983 Equipment Catalog, you will find our Special Chipper Knife Discount Program.

VOLUME DISCOUNT STRUCTURE

Order Totals		Discount
$2,000.00 - $3,499.99	=	5%
3,500.00 - 4,999.99	=	7%
5,000.00 - and over	=	10%

TERMS: 5% 10 DAYS, NET 30 DAYS—(If paid within 10 days of our invoice date you can deduct 5% off the invoiced amount of the parts.)

"FLYER SALE ITEMS"

Each month we will run a SALE on some current, fast moving parts which are lsited in our 1983 Equipment Catalog.

PRICES EFFECTIVE: October 1 to November 30, 1983

FLYER SALE ITEMS

PART NO.	DESCRIPTION	CATALOG PAGE NO.	CURRENT WHOLESALE PRICE	FLYER PRICE	FLYER ORDER QTY.	FLYER QTY. PRICE
24541-530	Roller Bearing	209	$ 52.53	$ 49.00	—	$238.00
26678-233	Solenoid Valve	270	335.40	280.00	3	238.00
26811-067	Tie Rod Cylinder	315	98.83	86.00	5	76.00
26816-145	Tie Rod Cylinder	315	90.25	79.00	5	69.00
26838-241	Filter Element	333	6.66	6.00	24	5.50
26846-311	Hydraulic Accumulator	335	224.54	195.00	3	180.00
30277-010	15" Shear Knife	394	161.50	150.00	6	125.00
30219-021	20" Shear Knife	394	446,25	375.00	4	300.00
42151-420	PSP & PS8 Top Infeed-Shell	408	81.97	72.00	65.00	
30160-480	48" Fan Blade	366	28.33	23.00	6	19.00
40001-750	75" Chipper Clamp - 5/8" Chip	361	209.42	187.00	6	169.00
40004-750	75" Chipper Clamp - 5/8" Chip	361	209.42	187.00	6	169.00
40230-850	22" Transition	381	668.41	581.00	2	550.00
40101-855	30" Cat Chain - per 6'8" section	392	588.31	500.00	6	450.00

Pictured above from left to right is the staff of Morbark's Parts Department: Gary Rau, Al Troop, Bruce Welch, Jim Bardos, Roger Flaugher and Lon Morey

*** * * PLEASE INDICATE THAT YOU SAW IT IN THE FLYER AT THE TIME YOU PLACE YOUR ORDER * * ***

"USED AND/OR REBUILT"

These are parts which have been replaced on equipment sent in for rebuild. Some have been rebuilt or reconditioned and others will be sold as is. These parts will be covered by a 30 day 50/50 warranty.

CHAR-LYNN HYDRAULIC MOTOR
8,000 Series - Rebuilt 57 Cu. In.
STR Key 2¼" Diameter Shaft

Char-Lynn Part No.: MD080-57
Our Part No.: 26731-503

List Price	Flyer Price
$1,185.00	$533.25

CHAR-LYNN HYDRAULIC MOTOR
8,000 Series - Rebuilt 28 Cu. In.
STR Key 2¼" Diameter Shaft

Char-Lynn Part No.: MD080-28
Our Part No.: 26731-501

List Price	Flyer Price
$1,118.00	$503.10

TRW ROSS GEROLOR MOTOR REBUILT
29 Cu. In. - 1" Splined Shaft - ⅞-14 Ports

Ross Part No.: MAE 34-002-A-1
Our Part No.: 26726-081

List Price	Flyer Price
$597.41	$330.00

REDUCED

TRW ROSS GEROLOR MOTOR REBUILT
17.8 Cu. In. - 1" Splined Shaft
⅞-14 Ports

Ross Part No.: MAB 24-002-A-1
Our Part No.: 26726-041

List Price	Flyer Price
$280.58	$165.00

REDUCED

"EXCESS AND/OR OBSOLETE PARTS"

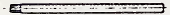
These are parts we have found ourselves overstocked in or parts which have become obsolete in our current production.

OREGON CHAIN SAW ACCESSORIES

10%

DESCRIPTION	VENDOR PART NO.	LIST PRICE	FLYER PRICE	REDUCED PRICE
Drive Sprocket	44749	$ 30.00	$ 15.00	$ 13.50
Roller Nose	11617	38.00	18.00	16.20
Chipper Chain	10AC-94E	31.00	16.50	14.85
Chipper Chain	10AC-88E	34.96	17.48	15.73
Drive Hub	118C	29.50	14.75	13.28
3½' Saw Bar	11716	163.00	81.50	69.25
3' Saw Bar	11421	155.56	77.78	66.11

SPLINE SHAFTS



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10%

PART NO.	DESCRIPTION	LIST PRICE	FLYER PRICE	REDUCED PRICE
150 x 8½	Full Key Spline Shafts 1½ x 8½	$49.70	$19.49	$17.54
150 x 9	Full Key Spline Shafts 1½ x 9	50.28	19.72	14.75
150 x 9½	Full Key Spline Shafts 1½ x 9½	50.85	19.94	17.95
150 x 10	Full Key Spline Shafts 1½ x 10	51.40	20.18	18.14
150 x 10½	Full Key Spline Shafts 1½ x 10½	51.73	20.29	18.26

EXTENSION SPRING
With Hook Ends

1⅝ OD x 17" Long
Our Part No.: 24741-615

List Price	Flyer Price
$10.60	$8.23

NORWESTER TOP INFEED WHEEL
Left Hand

Part No.: 42142-614

List Price	Flyer Price
$403.40	$244.98

CONVEYOR IDLER ROLLS
4" Diameter x 22⅞

Our Part No.: 24211-315

List Price	Flyer Price
$87.48	$48.31

20" SHEAR HOLDER
2½" Diameter Pin

Part No.: 40245-021

List Price	Flyer Price
$2,301.39	1,242.73

CONVEYOR CAST SPROCKET

For 55 Chain - 13 Tooth - 1¾" Bore
Our Part No.: 24281-013

List Price	Flyer Price
$75.22	$49.77

NORWESTER INFEED
Shoe and Shaft Assemblies

Right Hand 42027-814
Left Hand 42028-814

List Price	Flyer Price
$504.53	$208.87

20" SHEAR HOLDER
2½" Diameter Pin

Part No.: 40246-021

List Price	Flyer Price
$2,301.39	$1,242.73

VICKERS SOLENOID OPERATED DIRECTRIONAL CONTROL VALVE OPEN CENTER - EXTERNAL PILOT

Vickers Part No.:
DG5S4-060CE-24DC-51
Our Part No.: 26678-201

List Price	Flyer Price
$348.00	$122.82

ELECTRIC MOTORS 3 PHASE 220/440V, NEW

PART NO.	H.P.	R.P.M.	FRAME SIZE	MAKE	LIST PRICE	FLYER PRICE
972-661	2	1800	184F	Newman	$ 158.40	$ 93.18
973-081	3	3600	184F	Newman	158.76	93.39
27973-062	3	1800	182T	Newman	211.68	124.52
27963-061	3	1800	213U	Newman	158.40	93.18
964-342	15	1200	284T	Delco	450.80	265.18
967-062	75	1800	405U	Newman	4,773.00	2,386.50
7967-362	100	1800	444U	Newman	5,756.00	2,878.00
7974-474	25	3600	256T	Lincoln	870.00	485.35

ELECTRIC MOTORS 3 PHASE 220/440 - USED (50-50 WARRANTY)

H.P.	RPM	FRAME SIZE	MAKE	LIST PRICE	FLYER PRICE
7½	1200	265U	Newman	$1,098.00	$421.60
15	1800	284U	Newman	501.19	185.8x
15	1200	284T	Delco	450.80	187.61
15	885	326U	Westinghouse	476.32	227.66
25	3535	284TS	Delco	576.94	277.01
30	3600	284US	Lincoln	583.65	298.14
75	1800	405US	Howell	1,085.16	525.36

GRESEN SPYT MONO BLOCK VALVES WITH HANDLES

Page 264 in catalog

RT NO.	VENDER NO.	SPOOL NO. 1	SPOOL NO. 2	SPOOL NO. 3	LIST PRICE	FLYER PRICE
64-401	SPYT-D3	D3	—	—	$136.61	$79.83
26664-403	SPYT-D3-DF4	D3	DF4	—	217.49	141.22
26664-406	SPYT-4	4	—	—	124.79	81.03
64-407	SPYT-4-4	4	4	—	186.67	121.21
64-418	SPYT-4-4-D3	4	4	D3	260.40	169.09

RWESTER TOP OUTFEED WHEEL
Left Hand

Part No.: 42139-614

List Price $448.16 | Flyer Price $268.15

JOHN DEERE HANDLE

John Deere Part No.: ALH829FA
Our Part No.: 24731-152

REDUCED

List Price $24.55 | Flyer Price $8.75

VICKERS SOLENOID OPERATED DIRECTIONAL CONTROL VALVE TANDEM CENTER - INTERNAL PILOT

Vickers Part No.:
DG5S4-068-CX-T-R-24DC-51
Our Part No.: 26678-232

List Price $404.00 | Flyer Price $166.19

DE-STA-CO CLAMP

DE-STA-CO Part No.: 67005

List Price $36.85 | Flyer Price $10.41

HARDENED SPLIT STEEL BUSHINGS

Page 168 in catalog

REDUCED

T NO.	O.D.	I.D.	LENGTH	LIST PRICE	FLYER PRICE	REDUCED PRICE
128-011	2	1½	1¼	$7.60	$4.47	$3.58
128-012	2	1½	1½	8.60	5.06	4.05
8-014	2⅜	2	1½	9.12	5.36	4.29

BUNTING BRONZE BUSHINGS

Page 168 in catalog

REDUCE

PART NO.	I.D.	O.D.	LENGTH	LIST PRICE	FLYER PRICE	REDUCED PRICE
23126-025	1¼	1½	3½	$20.22	$11.89	$10.70
23126-031	1⅝	2		23.68	13.93	12.54
23126-045	2	2½		43.92	25.84	23.26
23126-051	2½	2¾		36.20	22.47	20.22
23126-052	2½	3	4	54.72	32.19	28.97
23126-055	2$^{15}/_{16}$	3$^{7}/_{16}$	3½	32.76	19.27	17.34
23126-061	3	3⅜	4½	69.12	40.66	36.59
23126-071	4	4½	4	89.84	52.49	47.24

*** PLEASE INDICATE THAT YOU SAW IT IN THE FLYER AT THE TIME YOU PLACE YOUR ORDER ***

SAVAGE AND CROWN LOADER PARTS

DESCRIPTION	VENDOR PART NO.	VENDOR	LIST PRICE	FLYER PRICE
Grapple Cylinder	1181	Savage	$335.94	$264.75
Live Heel Cylinder	1186	Savage	843.32	632.49
Live Heel Cylinder	1503	Savage	684.53	513.40
Jib Boom Cylinder	1557	Savage	795.53	596.65
Swivel Joint	1164	Savage	79.44	59.58
Bucket Cross	L-6012	Savage	128.64	96.48
Clevis	B-6008	Savage	154.89	116.17
Rotator Assembly	28-012	Crown	154.89	116.17
Timken Cup	522	Crown	18.12	8.06
Timken Cone	529	Crown	29.72	14.86
2" Nut with set screw	SC-8027	Savage	10.82	6.75
2" Lock Nut	SC-8008	Savage	15.41	11.56
1" Splined Insert	6039	Savage	17.60	9.45
Cushion Valve (Gresen DXV50)	SC-5502	Savage	103.81	77.85
Bearing Cone	SC-7508	Savage	11.83	8.87
Bearing Cup	SC-7507	Savage	5.61	4.21

TIMKEN BEARING CONE

Bore 1.5" - Width 1.01"

Timken Part No.: 2788

List Price $10.85
Flyer Price $4.79

BORG WARNER TORQUE H

30 to 1 Ratio use with
Eaton 3930 Series Hydraul
Motor with Splined Shaft

List Price $1,115.30
Flyer Price $557.65

STEEL PLATE SPROCKETS

Center Bores as Listed Below

CHAIN SIZE	NUMBER OF TEETH	BORE	LIST PRICE	FLYER PRICE
60	21	1¾ Hub	$ 14.00	$ 5.79
60	21	2⅞	14.00	5.79
60	26	1⁷⁄₁₆ Hub	16.00	[illegible]
60	30	2½	18.20	[illegible]
60	48	1	30.54	11.36
60	48	5½	30.54	[illegible]
60	54	1	35.80	[illegible]
60	60	2¹⁵⁄₁₆	44.20	[illegible]
60	10	1	12.43	4.63
80	14	1	14.17	[illegible]
60	21	2½	20.71	7.70
60	21	3⅛	20.71	7.70
60	28	1	26.78	[illegible]
60	28	2	28.78	10.70
80	28	5⅛	28.78	10.70
60	38	1	44.91	[illegible]
60	60	1¼	102.46	[illegible]
80	60	2¹⁵⁄₁₆	102.46	[illegible]
100	12	3⅛	16.44	7.02
100	38	1¼	84.40	[illegible]
100	40	1¼	94.80	[illegible]
100	40	5	94.80	40.46
100	45	2¹⁵⁄₁₆	118.00	50.37

HYDRAULIC HOSE ASSEMBLY

1" ID x 24" Long - 1" NPT Male
Booth Ends - Spec: SAE 100R2

Aeroquip Part No.: FG 1013MMM0240
Our Part No.: 26567-024

List Price $19.51
Flyer Price $8.78

TIMKEN BEARING CUP

O.D. 5.125" - Width 1.25"

Timken Part No.: 632
Our Part No.: 23775-035

List Price $28.88
Flyer Price $19.40

TIMKEN BEARING CONE

Bore 0.9375 - Width 0.7810"

Timken Part No.: 1779

List Price $10.76
Flyer Price $4.77

DODGE PILLOW BLOCK BEARING

3⁷⁄₁₆" - 4" Shaft Height
⅞" Bolt
Bolt Center 9¹¹⁄₁₆ Min. - 12⁹⁄₁₆ Max.

Dodge Part No.: SCM-3⁷⁄₁₆
Our Part No.: 23936-049

List Price $239.82
Flyer Price $163.08

DODGE CHAIN COUPLER HALF

80 Chain 20 Tooth Style F
For 3020 Bushing
Our Part No.: 24333-121

List Price $98.60
Flyer Price $58.00

V-BELT 8V SECTION

Sold In Matched Sets of (6 or 8)
(Domestic) - 250.0" O.D.

Vendor Part No.: 8V2500
Our Part No.: 24163-117

List Price $145.18
Flyer Price $110.89

DELTROL RELIEF VALVE

Part No.: RV-6
Set at 1500 PSI - ¾" NPT Ports

List Price $78.26
Flyer Price $39.46

CONVEYOR IDLER ROLLS

4" Diameter x 20⅞

Our Part No.: 24211-313

List Price $84.91
Flyer Price $ 5.56

SEQUENCE VALVE FLUID CONTROLS INC.

With Built In Check - 0-600 PSI
Set at 200 PSI - ⅜" NPT Ports - Adjustable
Part No.: ISD12-P3-6S

List Price	Flyer Price
$93.46	$32.40

DODGE CHAIN COUPLING COVER

Size #60
Our Part No.: 24333-013

List Price	Flyer Price
$59.16	$30.40

DELTROL OUTLET SECTION

¾ NPT Top and Side Ports
Part No.: D5-O-E

REDUCED

List Price	Flyer Price
$66.14	$29.17

BROWNING CHAIN COUPLING COVE

80Q
Our Part No.: 24331-032

List Price	Flyar Price
$60.60	$31.46

REXNORD PILLOW BLOCK BEARING

1½" Bore - 1⅞" Shaft Height
For Some PS-8 Cutterheads
Part No.: ZA-108
Our Part No.: 23944-117

List Price	Flyer Price
$108.30	$63.53

DODGE CHAIN COUPLING COVER

Size #80
Our Part No.: 24333-015

List Price	Flyer Price
$101.19	$52.80

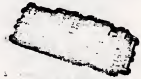
DELTROL INLET SECTION

¾ NPT Top and Side Ports
Part No.: D5-I-E

REDUCED

List Price	Flyer Price
$73.95	$31.48

COUPLING CHAIN ASSEMBLY



Dodge 8020 Chain
80 Chain 20 Teeth
Our Part No.: 24333-005

List Price	Flyer Price
$68.80	$40.47

BROWNING SHEAVE

6 Groove - R1 Bushing
"C" Section Belts
18" Pitch - 18.4" O.D.
Part No.: 6C180R
Our Part No.: 24223-515

List Price	Flyer Price
$299.78	$149.89

ROD CLEVIS

Texas Hydraulics
1" Dia. Pins - 1" Thread (Fine)
Our Part No.: 26818-102
Part No.: 60002

List Price	Flyer Price
$15.05	$7.60

DELTROL STACK TYPE DIRECTIONAL CONTROL VALVE

4-Way Open Center Float
Spring Return to Neutral - ½" NPT Ports
Part No.: D50-FA2

REDUCED

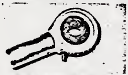
List Price	Flyar Price
$115.73	$57.29

SWIVEL ADAPTOR

90° 1½" NPT Each End - 360° Swivel
Part No.: PS24-PU24-P24
Our Part No.: 26591-029

List Prica	Flyer Price
$199.00	$117.06

MALE ROD END



Self-Aligning - Bore 1"
Male 1¼"-12 TPI Right Hand
Part No.: TRE-16
Our Part No.: 23924-009

List Price	Flyer Price
$64.57	$37.98

COUPLING SPIDER

Magnalox - Model 670

Magnalox Part No.: 670
Our Part No.: 24326-063

List Price	Flyer Price
$15.51	$10.07

DELTROL STACK TYPE DIRECTIONAL CONTROL VALVE

4-Way Tandem Center 3-Position Datent
½" NPT Ports
Part No.: D50-AB2

REDUCED

List Price	Flyer Price
$114.66	$55.78

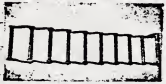
BROWNING CHAIN COUPLING COVER

60Q
Our Part No.: 24331-031

List Price	Flyer Price
$43.60	$22.64

WELDED STEEL DRAG CHAIN

6.0" Pitch - 20 Links Per 10'



Vendor Part No.: WSD110
Our Part No.: 24256-102

List Price	Flyer Price
$20.12	$10.98

ANCHOR PUMP FLANGE

3" NPT Pipe Size - 3" Pad

Anchor Part No.: W43-48-48
Our Part No.: 25352-556

List Price	Flyer Price
$38.45	$15.38

CARBIDE VERTICAL ANVILS

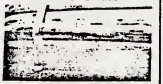
PART NO.	CHIPPER SIZE	ANVIL SIZE	LIST PRICE	FLYER PRICE
40189-480	48"	12 x 3 x 1	$247.32	$123.66
40189-580	58"	15¾ x 3 x 1	297.42	148.71
—	75"	20 x 3½ x 1½	342.78	171.39

FLANGE BEARING

SEAL MASTER — SF-26 1⅜"
4⅛ Bolt Centers ½" Bolt

List Price	Flyer Price
$42.60	$20.25

SYNTHETIC COVER HYDRAULIC HOSE



K410 - Hytron - ⅝" ID - Imperial Eastman

REDUCED

List Price	Flyer Price
$3.10/ft.	$.83/ft.

MORSE CONTROL ASSEMBLY DUAL CONTROL

Part No.: E44716-1

List Price	Flyer Price
$48.65	$22.10

CHAIN LINK ATTACHMENTS

No. C55 Chain Style K2

List Price	Flyer Price
$4.67	$2.10

FLEET GUARD ADAPTOR HEAD

For LF-777 By-Pass Filter
Part No.: 3304173S
Our Part No.: 29214-216

List Price	Flyer Price
$49.96	$19.59

HUB WHEEL BOLTS

Fine Thread

Size	List Price	Flyer Price
⅝ x 1¾	$1.76	$.62
⅝ x 2¼	2.10	.79
9/16 x 1	1.61	.69

DRIVE SHAFT ASSEMBLY

For PS-8 Peelers with Chrysler Engine

List Price	Flyer Price
$179.60	$89.60

REXNORD PILOTED FLANGE BEARING

ZBR-200-G-2 - 2" Bore - 5¾" Bolt Center

List Price	Flyer Price
$146.38	$73.19

HYDRAULIC IN-LINE SWIVELS WITH GREASE FITTING

¾" NPT Ports - 360° Rotation - S8-PF-12

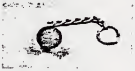
List Price	Flyer Price
$21.60	$9.48

DUST CAPS FOR MALE COUPLERS

S49-4 for safeway
S 40-4 ½" NPT Coupler

List Price	Flyer Price
$2.15	$1.06

DUST PLUGS FOR FEMALE COUPLERS



S44-4 for Safeway
S-40-4 ½" NPT Couplers

List Price	Flyer Price
$2.15	$1.06

HYDRAULIC QUICK COUPLER

BRUNING SM600
¾" NPT Ports

	List Price	Flyer Price
Male	$10.93	$ 4.69
Female	16.76	6.31
Complete	20.61	12.40

SELF ALIGNING BUSHINGS

20SF32 Bore 2" - OD 3.1675
Width: 1.750"

List Price	Flyer Price
$48.52	$28.54

GRESEN TWIN HYDRAULIC FILTER

10 Micron - 1½" NPT Ports
Max. Press 200 PSI

Our Part No.: 26838-202

List Price	Flyer Price
$147.94	$93.50

MODEL SF100 SUMP TYPE FILTER

Gresen - 1¼" NPT Ports
60 Mesh Wire Screen - 26839-005

List Price	Flyer Price
$36.00	$18.00

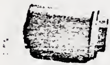
VICKERS HYDRAULIC FILTER ASS'Y.

OFM-101-10

10 Micron - 1" NPT Ports
Cartridge Element

List Price	Flyer Price
$16.50	$7.25

MICHIGAN FLUID POWER SUMP FILTERS



2" NPT Ports - 100 Mesh

List Price	Flyer Price
$32.75	$15.90

CHAR LYNN MODEL IF301515 DOUBLE HYDRAULIC FILTER ASS'Y.

1¼" NPT Ports - Including filter condition indicator - Spin on elements

List Price	Flyer Price
$26.76	$14.22

DONALDSON PRE-CLEANER BOWL

Donaldson Part No.: P01-6330
Fits Precleaner PBH00-0254
Our Part No.: 29321-240

List Price	Flyer Price
$12.37	$6.41

DONALDSON PRE-CLEANER

Donaldson Part No.: PBH00-0254
Inlet Size: 3¾ I.D.
Our Part No.: 29321-217

List Price	Flyer Price
$38.10	$20.75

DONALDSON PRE—CLEANER

Donaldson Part No.: PBH00-0236
Inlet Size 2½"
Our Part No.: 29321-223

List Price	Flyer Price
$19.74	$13.58

AMBAC FLUID POWER DIRECTIONAL CONTROL SOLENOID OPERATED

Open Center - 12 or 24 Volt D.C.

Ambac Part No.: 5-C32-16T
Our Part No.: 26661-608 - 12 Volt
26661-609 - 24 Volt

List Price	Flyer Price
$253.82	$164.32

MTE FLOW DIVIDER

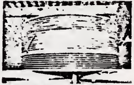
4 Section Gear Divider
1" NPT Inlet & Outlet

MTE Part No.: SM300-2020

List Price	Flyer Price
$485.20	$196.43

BROWNING POLY V SHEAVE

24" Pitch · 24" O.D. - S1 Bushing
Use "M" Belt 3" Wide - ⅜" Rib



Browning Part No.: 8M240S

List Price	Flyer Price
$277.20	$154.10

VICKERS HYDRAULIC MOTOR

Through Shaft - 1 5/16-12 Ports
SAE B Splined Shaft - 15 Tooth
Through Shaft 25 Tooth

Vickers Part No.: MFE 19X-2-30
Our Part No.: 26754-702

List Price	Flyer Price
$445.80	$281.25

AMBAC FLUID POWER DIRECTIONAL CONTROL SOLENOID OPERATED

Closed Center - 12 or 24 Volt D.C.

Ambac Part No.: 5-C31-16T
Our Part No.: 26661-603 - 12 Volt
26661-604 - 24 Volt

List Price	Flyer Price
$214.81	$139.49

FAFNIR FLAT IDLER PULLEYS

.515" to .510" Bore - 6¼" O.D.
1 7/16" Wide

Fafnir Part No.: 008-10483
Our Part No.: 24211-213

List Price	Flyer Price
$46.60	$21.53

BROWNING "W" COMPANION SHEAVE

For 4430 Variable Speed Belts
20.0" Pitch - 20.5" O.D.

Browning Part No.: 1W200R
Our Part No.: 24238-013

List Price	Flyer Price
$208.58	$122.69

KOENING RIGHT ANGLE SPEED REDUCERS

1¼" Dia. Output Shaft - 36 to 1 Ratio
3000 Inch - Pound Capacity

Koening Part No.: HSR-38
Accepts Hydraulic Motor With SAE A 2 Bolt Flange with 1" Dia. Shaft

List Price	Flyer Price
$426.96	$298.87

HEX HEAD LOCK NUT

2½" Dia. - 12 Thread Per Inch
4" Across the Flats

Our Part No.: 22533-022

List Price	Flyer Price
$79.76	$41.91

TANKS ENDS DEEP DISH

14" O.D. - 285C or 515 Material

Our Part No.: 25531-632

List Price	Flyer Price
$51.17	$29.92

BROWNING "W" COMPANION SHEAVE

For 4430 Variable Speed Belts
16.0" Pitch - 16.5" O.D. - R1 Bushing

Browning Part No.: 1W160R
Our Part No.: 24238-011

List Price	Flyer Price
$169.80	$99.88

T.B. WOODS SURE FLEX

Coupling Half
Use with "E" Bushing

Coupling Size No. 12

List Price	Flyer Price
$97.36	$34.80

PILOT CHECK VALVE FLUID CONTROLS INC.

Double Pilot Check - ⅜" NPT Ports

Fluid Controls Part No.: 4kk33-N3-S

List Price	Flyer Price
$84.60	$35.16

PERMCO SINGLE HYDRAULIC PUMP

1¼" Keyed Shaft - 1¾" Gears
Four Bolt Mount

Permco Part No.: P3700-A331-AZZ-1700

List Price	Flyer Price
$679.06	$456.65

V-BELT 8V SECTION

Sold In Matched Sets of (6 or 8)
(Domestic) - 236.0" O.D.

Vendor Part No.: 8V2360
Our Part No.: 24163-116

List Price	Flyer Price
$137.09	$104.71

T.B. WOODS SURE FLEX

Coupling Insert

Coupling Size No.12

List Price	Flyer Price
$93.17	$40.80

BROWNING 1 GROOVE SHEAVE

5.0" Pitch A Belt - 5.4" Pitch B Belt
2" Bore with Keyway and Set Screw

List Price	Flyer Price
$20.42	$9.19

PHELPS BLOWER IMPELLER

6 Blade - 1¼" Bore with Keyway

List Price	Flyer Price
$263.94	$103.51

KYSOR OF CADILLAC

Automatic Shutter

Kysor Part No.: M2745

List Price	Flyer Price
$291.97	$142.33

* * * PLEASE INDICATE THAT YOU SAW IT IN THE FLYER AT THE TIME YOU PLACE YOUR ORDER * * *

CONVEYOR CAST SPROCKET

For C-188 Chain - 7 Tooth - 1 7/16 Bore

List Price	Flyer Price
$67.60	$30.66

SLIP YOKE

1¾ 10 Spline - 13/32 Free Hole In Flange
With Dust Caps and Washers

List Price	Flyer Price
$155.88	$62.35

END YOKE

2" Round Hole with key way
13/32 Free Hole in Flange
Our Part No.: 24112-175 - 62N Series

List Price	Flyer Price
$126.20	$50.46

DELTROL MODEL D40

Single Spool Directional Control V
¾" NPT Ports
Spring Return to Neutral
3-way Fandem Center
Part No.: D40-DA-3

OTV

List Price	Flyer Price
$118.76	$50.00

WIRE ROPE SHEAVE

Bronze Bushed
8 OD x 1 5/8 wide x ¾ ID
Our Part No.: 24211-823

List Price	Flyer Price
$73.26	$36.[illegible]

SPLINE PLUG

1¾ 16 Spline For 3 OD x .120 Wall Tube
Rockwell 50 NPS28-31
Our Part No.: 24112-180

List Price	Flyer Price
$98.78	$39.50

CROSS & BEARING KIT

4-Low Wing Bearings with 3/8"-24
Threaded Holes Rockwell CP62N-47
Mechanics 114-6143
Our Part No.: 24112-172

List Price	Flyer Price
$96.50	$46.35

2 GROOVE 16.0" PITCH DIA. SHE E
OD-SF STYLE BUSHING

"C" Section Belt
Our Part No.: 24223-914

List Price	Flyer Price
$145.80	$69.35

END YOKE

1½" Round Hole - L16 Series
Rockwell L16SYR24

List Price	Flyer Price
$35.60	$14.24

WELD YOKE

13/32 Free Hole in Flange for 3 OD x .120
Wall Tube - Rockwell 62NY44
Our Part No.: 24112-171

List Price	Flyer Price
$108.21	$43.28

HY-PNEU CHECK VALVE STEEL

½" NPT Ports
CV504S
Our Part No.: 26631-185

List Price	Flyer Price
$17.12	$8.82

FAFNIR BALL BEARING INSERT

2" Bore - 3.9377" O.D.
Part No.: G1200-KRR
Our Part No.: 23262-025

List Price	Flyer Price
$42.50	$25.00

SPLINE PLUG

¾ 10 Spline - For 3 OD x .120 Wall Tube
Rockwell 62NPS28-13
Our Part No.: 24112-179

List Price	Flyer Price
$88.91	$35.56

SLIP YOKE

1¾ 16 Spline 13/32 Free Hole in Flange
with Dust Caps and Washers
Rockwell 62NLS28-2
Our Part No.: 24112-178

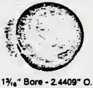
List Price	Flyer Price
$167.47	$74.99

MICROMETER NEEDLE VALVE
DELTROL FLUID PRODUCTS

M201 S4, ¼" NPT Male &
Female Ports - Steel
Our Part No.: 26642-003

List Price	Flyer Price
$19.00	$8.50

SEAL MASTER BALL BEARING INSE T



1 3/16" Bore - 2.4409" O.D.
Part No.: ER-19
Our Part No.: 23613-211

List Price	Flyer Price
$26.46	$15.56

UNIVERSAL JOINTS
CROSS & BEARING KITS

CP-35R for 1½" U-Joint
Our Part No.: 24113-104

List Price	Flyer Price
$26.99	$10.30

KYSOR OF CADILLAC
Automatic Shutter

Kysor Part No.: M2760

List Price	Flyer Price
$204.87	$99.88

UNIVERSAL JOINTS

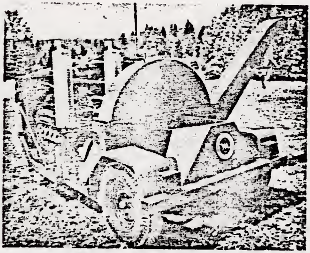
		List Price	Flyer Price
24113-005	1¼" Spline 10 Spline	$27.48	$13.63
24113-007	1¾" Spline 16 Spline	61.00	29.86

VICKERS COIL INSERT
12VDC - Dry

Vickers Part No.: 291583

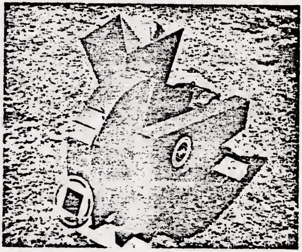
List Price	Flyer Price
$67.00	$33.50

MORBARK'S EEGER BEEVER AND SUPER BEEVER DROP SPOUT CHIPPERS TO UTILIZE POLEYARD — SLASHER — BUNDLEBUNCHER YARD TRIMMINGS AND WASTE FROM LUMBER CUT-UP OPERATIONS



SUPER BEEVER
DROP SPOUT CHIPPER

- 18" Diameter Capacity
- 1-Knife Chipper - Standard
  2-Knife Chipper - Optional
- Portable - Standard
  Stationary - Optional
- Horsepower requirements 50-HP to 200-HP depending on application and volume
- Price $9,500.00 for portable unit (1-Knife less power)
- End discharge for direct van loading

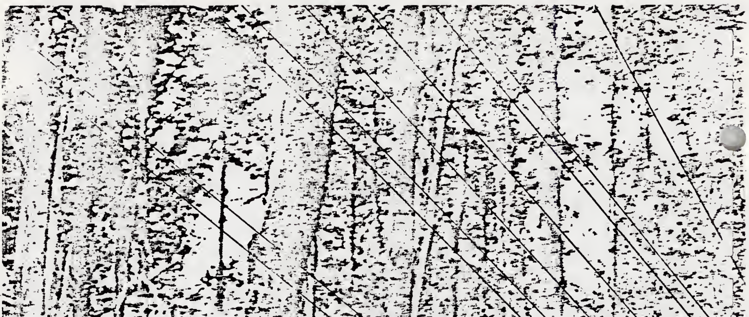


EEGER BEEVER
DROP SPOUT CHIPPER

- 10" Diameter Capacity
- 1-Knife Chipper - Standard
  2-Knife Chipper - Optional
- Stationary - Standard
- Horsepower requirements 50-HP to 75-HP depending on application and volume
- Price $3,950.00 (1-Knife less power)
- End discharge for direct van loading

The Eeger Beever and Super Beever Drop Spout Waste Wood Chippers were unveiled at the New Orleans Equipment Show and both machines show great promise in providing a means to utilize and eliminate the disposal problem of trim blocks from poleyards, slasher and bundlebuncher yards, and trimmings and blocks from lumber cut-up plants.

The Super Beever was taken to several yards after the New Orleans Show and proved to meet the needs in utilizing the waste from poleyards. The machine also ran well at the slasher yards. However, a significant percentage of the material is still too large to feed into the machine so we are building a larger unit with a more open spout. We will announce its introduction in an upcoming issue. For you poleyard operators and those of you who don't have blocks over 12" in diameter we have an answer.....it's inexpensive, does the job, will get rid of a disposal problem and will generate a product that will generate you revenue.



MORBARK INDUSTRIES, INC
P.O. BOX 1000
WINN, MICHIGAN 48896
PHONE (517) 866-2381
TOLL FREE 800-62[illegible]-3540
TELEX 22[illegible]43

BULK RATE
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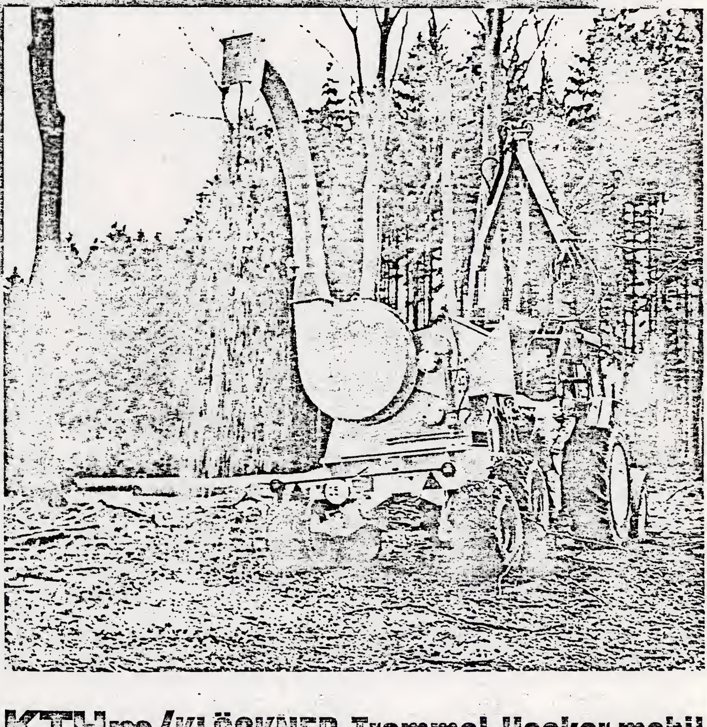
Fostoria, Ohio
Permit No. 13

KTH
m

KLÖCKNER

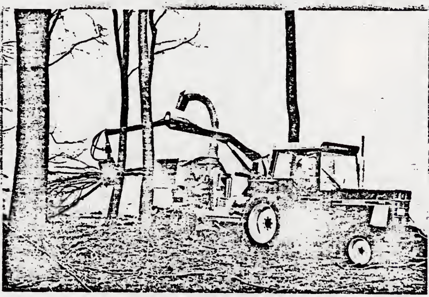


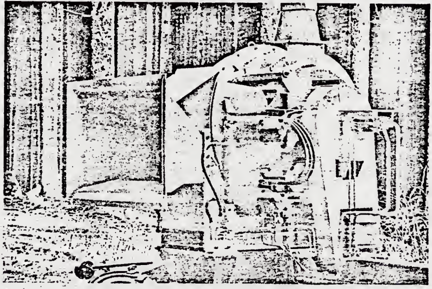
KTHm/KLÖCKNER-Trommel-Hacker mobil

KTH
m

Einfache und funktionsgerechte Arbeitstechnik

Die mobile Klöckner-Trommelhackmaschine bildet zusammen mit dem Fahrgestell und dem aufgebauten Hydraulikkran eine komplette Einheit und kann an jedes geeignete Fahrzeug wie z. B. einen Traktor oder Unimog montiert werden. Der Antrieb des Trommel-Hackers erfolgt über eine Zapfwelle der Zugmaschine.





Für den harten täglichen Arbeitseinsatz

KTH m

Ausgehend von unseren vieltausendfach bewährten Trommelhackmaschinen haben wir auch für den mobilen Einsatz an unserem Trommel-Hackmaschinen-System festgehalten und somit nicht auf die vielen Vorteile einer Trommel-Hackmaschine gegenüber einem Scheiben-Hacker verzichtet.

Der Trommel-Hacker, eine robuste, unkomplizierte Bauweise mit Einzugswalzen, die das Aufgabematerial sicher bis dicht an den Hackrotor führen, bedarf eines minimalen Wartungsaufwandes. Die gute Zugänglichkeit zu allen Maschinenteilen garantiert einen einfachen und schnellen Wechsel der Hackmesser und des Gegenmessers, welches mehrseitig verwendbar ist.

Besondere Vorteile unserer Konstruktion

1. Kinetischer Auswurf der Hackschnitzel (Patent angemeldet)
2. Hydraulischer Antrieb der Vorschubwalzen in Abhängigkeit von der Rotordrehzahl mit Überlastsicherung (= gleichbleibende Hacklänge)
3. Hydrauliksystem mit Überdrucksicherung
4. Druckkontrolle im Hydrauliksystem an leicht zugänglichen Anschlüssen durchführbar.

Fahrgestell
Das Fahrgestell des Trommel-Hackers ist mit vier Niederdruckreifen ausgerüstet, die eine geringe Bodenbelastung und eine extrem gute Geländegängigkeit auch außerhalb befestigter Waldwege garantieren. Dadurch ergibt sich auch eine hohe Standsicherheit in unebenem Gelände.

Hydraulikkran:
Die ausgewählten Krane haben sich vielfach bewährt und sind gezielt auf die Einsatzfälle abgestimmt.

TECHNISCHE DATEN

Rotor speed
Knives
net weight

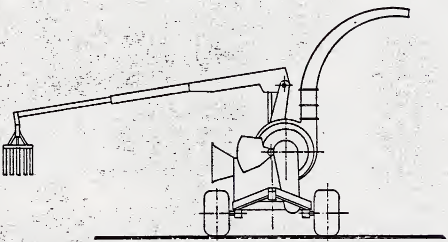
53,000

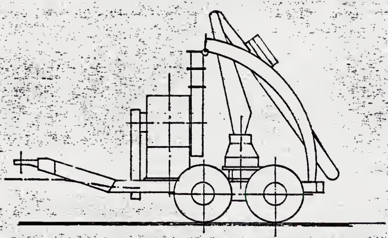
Type: KTH m	Hackquerschnitt mm	Eingangsleistung ** rm/h	Kraftbedarf ** kW	Messeranzahl Stück	Rotor-Ø mm	Gewicht (netto) kg
240 x 400 L-2W	240 x 430	12 - 30	45 - 110	2	760	2.500
300 x 500 L-2W	*300 x 530	30 - 40	60 - 190	2	1020	5.000
400 x 600 L-2W	*400 x 630	35 - 60	110 - 250	2	1320	5.500

* Die Hackhöhe liegt bei Astmaterial ca. 20% über dem angegebenen Wert.
** abhängig von Antriebsleistung, Holzart und Beschickung.

KLÖCKNER

KTH
m



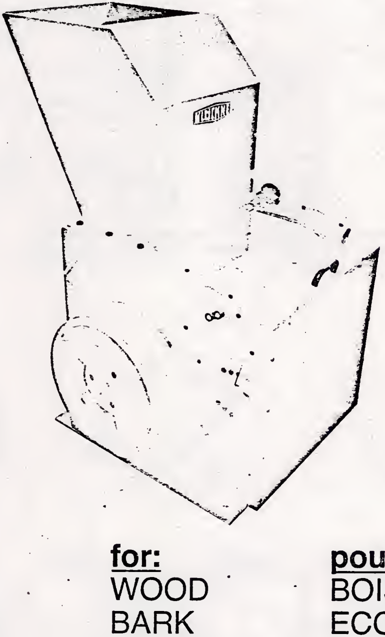


Gebr. **KLÖCKNER** GmbH + Co. KG
Maschinenfabrik
D-5239 Hirtscheid-Nistertal
Westerwald — West Germany
Telefon Bad Marienberg (0 26 61) 28-0
✆ 8 69 305 kloe d
+ gekloe nistertal/westerwald

Gebr. KLÖCKNER GmbH & Co.
Seit 1897

UNIVERSAL-ZERKLEINERER

UNIVERSAL HOGS – DÉCHIQUETEUSE UNIVERSELLE



für:	**for:**	**pour:**
HOLZ	WOOD	BOIS
RINDE	BARK	ECORCES
PAPIER	PAPER	PAPIER
u.v.a.	etc.	etc.

Besondere Merkmale:
- Extrem robuste Stahlkonstruktion
- überdimensionierte Pendelrollenlager
- einfache Bedienung
- wartungsarm
- vielseitige Einsatzmöglichkeiten
- alle Zerkleinerungswerkzeuge sind einzeln austauschbar
- sehr hohe Betriebssicherheit
- hohe Wirtschaftlichkeit

Special characteristics:
- High sturdy steel construction
- overdimensioned self-aligning bearings
- simple handling
- low maintenance
- multipurposed applications
- all cutting tools individual changeable
- high reliability in operation
- enormous efficiency

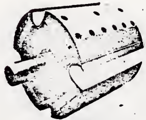
Caractéristiques principales:
- Construction en acier, extrêmement robuste
- Roulements à rouleaux articulés surdimensionnés
- Maniement simple
- Utilisation variée
- Peu d'entretien
- Tous les outils de déchiquetage sont échangéables individuellement
- Très grande sécurité de fonctionnement
- Grande rentabilité

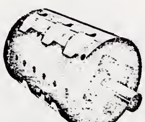
Typenbestimmung	**Type definition**	**Déterminiation de types**	TYPE ideal ideal ideal	 geeignet suitable approprié	 brauchbar useful utilisable
Aufgabematerial:	Feeding material:	Matériau à déchiqueter			
Gatterabfälle	Frame saw waste	Déchets de la scie multiple	KRC	KHM	KRW-S
Kappscheiben	Off-cuts	Disques de coupe	KRC-E	KRC	KRW-S
Stückige Holzabfälle	Short pieced wood waste	Déchets de bois en morceaux	KRW-S	KHM	KR C
Überlängen vom Scheibenhacker	Oversizes from disc-chippers	Surlongueurs du broyeur à disque	KR C	KRW-S	KHM
Schälspäne	Peelings	Copeaux d'écorcage	KRZ-E	KRC	KRW-S
Kisten und Paletten	Boxes and pallets	Caisses et palettes	KRW-Z	KHM	KRC
Spanplatten	Particle board waste	Panneaux particules	KRW-S	KHM	KRC
Faserplatten	Fibre board waste	Panneaux de fibres	KRW-Z	KRC	KHM
Rinde	Bark	Ecorces	KRZ-E	KRC	KHM
Kartonage	Cardboards	Cartonnage	KRW-Z	KRW-S	KR C

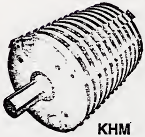
Bedingt zerkleinert jede Type/Rotor jedes genannte Material.

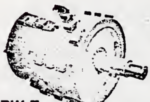
Limited all types/rotors are able to chip all said waste material.

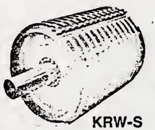
En peu déchiqueter en fonction de chaque type/rotor chaque matériau mentionné.

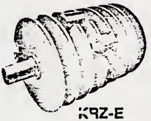

KRC

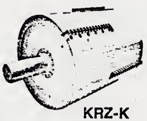

KRC-E


KHM


KRW-Z


KRW-S


KRZ-E


KRZ-K

Technische Daten ● Specification ● Caractéristiques techniques

❶ Type		Hackquerschnitt Infeed cross section Section de broyage mm	❷ Kraftbedarf Power required Puissance kW	Rotor Ø Rotor Ø Diamètre rotor mm	Zerkleinerer Tools Outils de déchiquetage Stück, pieces	Gewicht Weight kgs (net) Poids kg (netto)
KRC	100 x 400	100 x 400	11 – 22	300	2–4	650
	200 x 400	200 x 400	30 – 45	470	2–4	800
	300 x 600	300 x 600	45 – 75	600	2–4	1600
	300 x 800	300 x 800	45 – 90	600	2–4	1800
	400 x 600	400 x 600	45–110	760	2–4	2300
	400 x 800	400 x 800	55–132	760	2–4	2600
	400 x 1000	400 x 1000	55–160	760	2–4	3000
	500 x 800	500 x 800	75–160	1020	2–4	3300
KRC-E	200 x 400	200 x 400	30 – 45	470	8	850
	300 x 600	300 x 600	45 – 75	600	12	1700
	300 x 800	300 x 800	45 – 90	600	16	1950
	400 x 600	400 x 600	45–110	760	12	2450
	400 x 800	400 x 800	55–132	760	16	2800
	400 x 1000	400 x 1000	55–160	760	20	3200
	500 x 800	500 x 800	75–160	1020	16	3550
KRW-❸S/Z	200 x 400	200 x 400	30 – 55	470	S 27 Z 21	800
	300 x 600	300 x 600	45 – 90	600	S 39 Z 40	1600
	300 x 800	300 x 800	45–110	600	S 51 Z 52	1800
	400 x 600	400 x 600	55–132	760	S 39 Z 40	2300
	400 x 800	400 x 800	55–160	760	S 51 Z 52	2600
	400 x 1000	400 x 1000	75–200	760	S 63 Z 64	3000
	500 x 800	500 x 800	75–200	1020	S 68 Z 65	3300
KRZ-❹E/K	200 x 400	200 x 400	22 – 37	470	E 4 K 4	750
	300 x 600	300 x 600	37 – 55	600	E 7 K 6	1500
	300 x 800	300 x 800	37 – 75	600	E 9 K 6	1700
	400 x 600	400 x 600	45 – 90	760	E 7 K 8	2150
	400 x 800	400 x 800	55–110	760	E 9 K 8	2400
	400 x 1000	400 x 1000	75–132	760	E 11 K 8	2800
	500 x 800	500 x 800	75–132	1020	E 9 K 10	3050
KHM	200 x 400	200 x 400	18,5 – 45	470	30	950
	300 x 600	300 x 600	22 – 55	600	44	2000
	300 x 800	300 x 800	22 – 75	600	58	2200
	400 x 600	400 x 600	30 – 90	760	44	2700
	400 x 800	400 x 800	30 –110	760	58	3000
	400 x 1000	400 x 1000	37 –132	760	72	3500
	500 x 800	500 x 800	55 –160	1020	58	3800

❶ Die Kapazität ist abhängig vom Kraftanschluß, Aufgabematerial und der gewünschten Granulatgröße.

❷ Der Kraftbedarf ist abhängig von der Materialart, geforderter Leistung und der Größe des Granulats.

❸ S = Stufenzähne
Z = Zylinderschaftzähne

❹ E = Einzelmesser-Ausführung: produziert je nach Bedarf kleines oder großes Granulat für Feuerungen oder Humusbildung.
K = Kammleisten-Ausführung: produziert langfaseriges Granulat für Bodenabdeckung (windfest).

❶ Capacity depends on installed power, kind of material and required size of granule.

❷ Power required depends on kind of material, demanded capacity and size of granule.

❸ S = graduated teeth
Z = cylindrical teeth

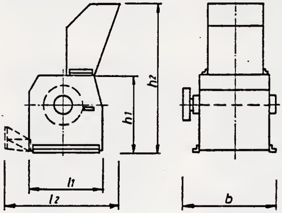
❹ E = Single-knife design: produces small or big granule for burning or humus formation.
K = Comb-rail design: produces long fibred granule for floor covering.

❶ La capacité est fonction de la puissance installée, du matériau à déchiqueter et de la granulométrie souhaitée.

❷ La puissance à installer est fonction du matériau à déchiqueter, du rendement démandé et de la granulométrie souhaitée.

❸ S = Dents à gradins
Z = Dents avec tiges cylindriques

❹ E = Exécution avec couteaux indépendants produit selon besoin une petite ou une grosse granulométrie pour des chauffages ou pour terre végétable.
K = Exécution en peigne produit une granulométrie a fibre longue pour la couverture du sol (résistant au vent).



Type	l 1	l 2	b	h 1	h 2
100 x 400	550	1120	820	480	1230
200 x 400	865	1515	950	675	1425
300 x 600	980	1750	1235	840	1540
300 x 800	980	1750	1435	840	1540
400 x 600	1080	2100	1350	1050	2050
400 x 800	1080	2100	1550	1050	2050
400 x 1000	1080	2150	1750	1050	2050
500 x 800	1520	2810	1630	1350	2550

alternative Trichterformen möglich
alternative infeed-chuts possible
Variations d'exécution de la trémie possibles

Konstruktion:

Der Maschinenständer ist eine im Baukastensystem gefertigte schwere und robuste Schweißkonstruktion. Die Rotoren sind mit Steckwellen ausgerüstet und laufen in staubdicht gekapselten Pendelrollenlagern. Die Flanschlagergehäuse sind zentrisch im Maschinenständer eingelassen und bieten somit gegenüber Stehlagern größte Sicherheit. Alle Zerkleinerungswerkzeuge sind schnell und einfach austauschbar. Diese Maschinen werden konstruiert, gebaut und ausgerüstet nach dem derzeit höchsten Stand in einer mit modernsten Werkzeugmaschinen ausgestatteten Fabrik nach der Devise: „Robust und präzise"

Construction:

Machine construction (side walls) in unitized construction, heavy and solid welded construction. Rotors with plugged shafts, over-sized antifriction bearings. Steel flange bearing cases centrically installed in machine side walls, optimal safety against pillow blocks. All tools easy and fast changeable. This machines are designed, constructed and equipped on the highest stand of technology in our factory with the most progressive machine tools, on the device "Solid and precise"

Construction:

Le bâti de la machine est une construction lourde et robuste en acier, système de construction par éléments. Les rotors sont équipés avec arbres changéables et avec des roulements à rouleaux articulés, étanchés contre la poussière. Les carters des paliers à bride sont centrés dans les paroies latérales de la machine et offrent ainsi une meilleure sécurité en comparaison avec des paliers fixes. Tous les outils de déchiquetage sont changéables rapidement et facilement. Ces machines sont construites, montées et équipées selon le meilleur standard actuel dans une usine, équipée avec les machines lesplus modernes ayant la dévise: «Robustesse et précision»

Produktions-Programm:

Trommelhacker
Scheibenhacker
Hackschnitzel-Zerspaner
Spanmühlen
Siebanlagen
Querförderer
Vibrationsförderrinnen
Dosierförderer
Transportbänder
Trogkettenförderer
Transportschnecken
Sonderkonstruktionen

Production-Program:

Drum chippers
Dise chippers
Flakers
Refining Mills
Siftars
Cross conveyors
Vibratory feeders
Dosing feeders
Belt conveyors
Chain conveyors
Screw feeders
Special constructions

Programme de fabrication:

Broyeurs à tambour
Broyeurs à disque
Fragmenteuses pour plaquettes
Moulins de réduction
Installations de tamisage
Transporteurs transversaux
Couloirs vibrants
Transporteurs à doser
Tapis transporteur
Transporteurs en auge à chaines
Vis de transport
Constructions spéciales

EUROPEAN WOODWORKING
MACHINERY LTD.
10 Home Farm Park, Drumcondra,
Dublin 9, Republic of Ireland.
Phone 01-379619

U.S.A. Office:
509 Pleasant Street, Webster City, Iowa 50595
Phone: 515-832-2157

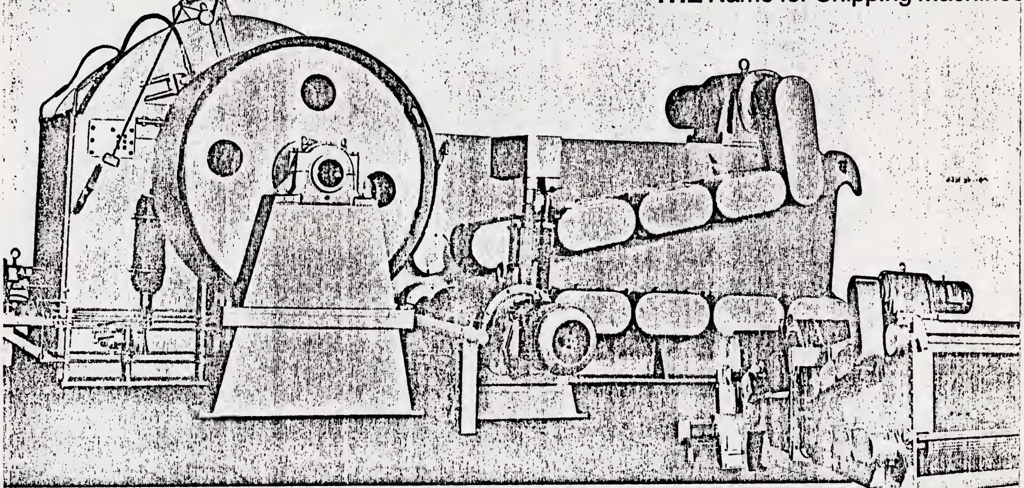
nbH & Co.

Westerwald

KLÖCKNER

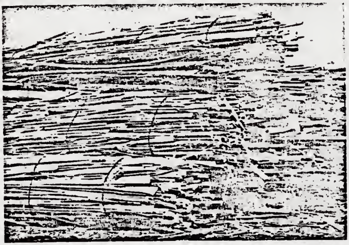
since 189

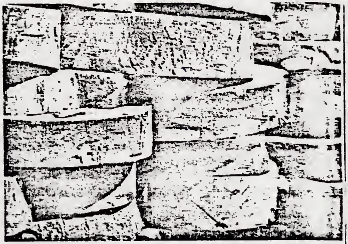
THE Name for Chipping Machines

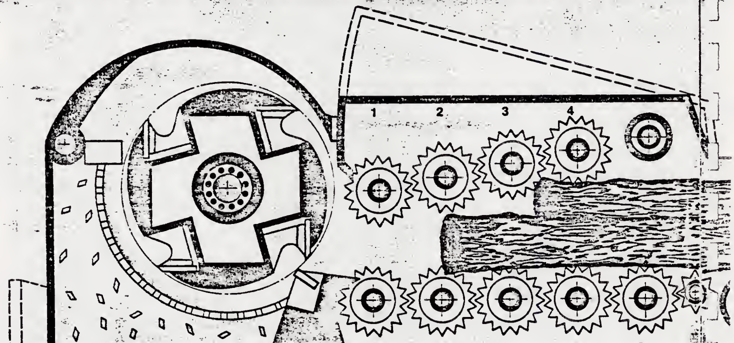


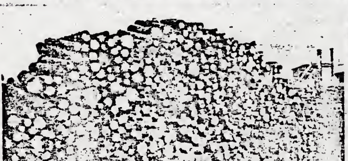
DRUM-CHIPPER

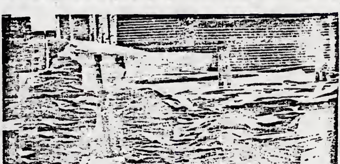
Material for the



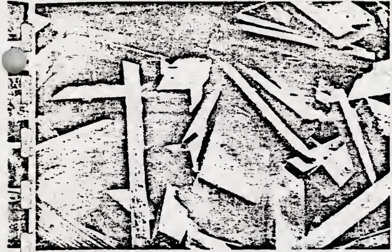


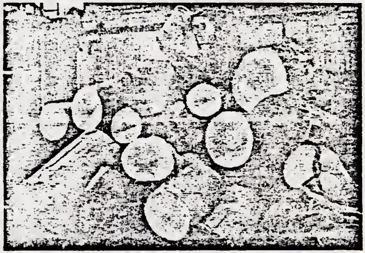






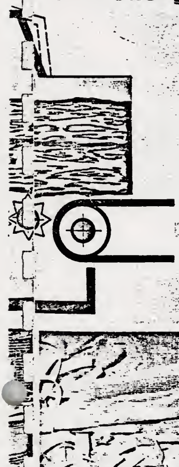
KLÖCKNER »Eats-Everything«



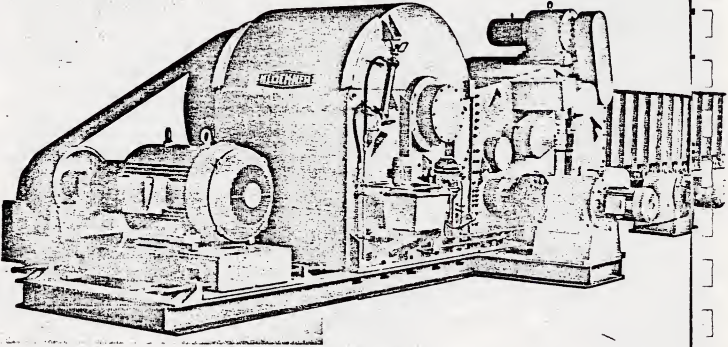


The KLÖCKNER »Eats-Everything«

The all-over experienced KLÖCKNER system

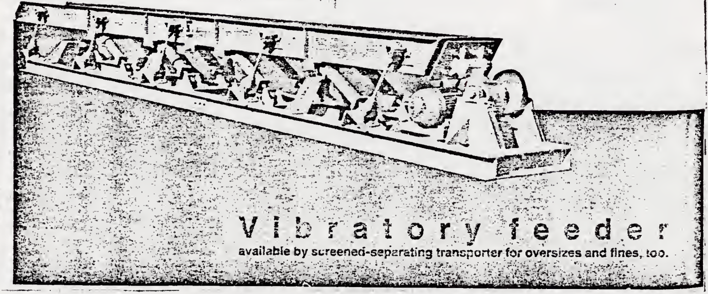


All rollers marked by even numbers or non-even ones, are changeable mutually. Reasonable the most wear is set on rollers no. 1 and no. 5, they are always on process. By experience, these two rollers should be removed to position 3 or 9, after some years because there is hardly a wear executed.
The automatic feed, developped by ourselves (interlocking feed rollers with specially designed teeth) has been fully accepted by the relevant industries and not been reached until now by any alternative. By permanent research in view of the way of operating use, we are always the first with the best in technology. The upper graded rollers in combination to the lower horizontal ones, do guarantee the continuous feeding of wood to the rotor. The rollers are driven by two gear motors.



INFEED

Our chippers in connection with chip-transport and infeed-equipments (belt conveyor, vibratory feeders and cross-conveyors) are resulting in a perfect chipping unit. When there is a conveyor belt added, a rough teethed fast rotating cleaning roller is protecting the rubber belt of being jamed by wooden-splints at the connection of machine-feed-aggregate to conveyor belt.
Large chipper units are recommended to the installation of a metal-detector to the prevent of a metal-free zone.



Vibratory feeder

available by screened-separating transporter for oversizes and fines, too.

KLÖCKNER The difference of cheap or expensive machines is not price - but technology.

FACTS ON KLÖCKNERs

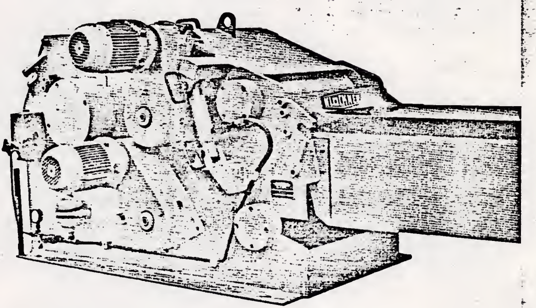
Due on experiences and progress in technology

More than 20 years of research, development and production of chipping-machines result in experience, and know-how due to the reputated manufacturer of chippers in Europe, improved by thousands of chippers working in all parts of the world. Our standard programm not only includes, the smallest but also the biggest types of yet produced drum chippers. They are operating in Europe as well as in the rough wood areas in Canada, Amazonas and Asia. Some of these chippers are processing on a drive of 2 x 750 kW by an infeed size of 1.200 x 1.000 mms and a capacity of more than 450 rm/h.

Who else is experienced in such giant chippers?

The progress in technology is only ingenious for the use of chippers by resulting on efficiency. A customer of KLÖCKNERs got more than the fact of superior technology but trust on the important extras as fast service, providing of all spare parts and the emergency service, secured.

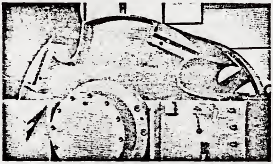
These are the improvals of a well-reasoned decision on KLÖCKNER-chippers.



KLÖCKNER KNIFE CLAMPING

① **MECHANICAL CLAMPING**

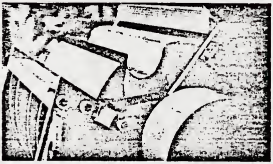
Knives located between clamping plates and rotor, clamped mechanically by JSK-Screws.



② **KNIFE-CENTRIFUGAL-WEDGE-CLAMPING**

Centrifugal wedge, pre-clamped mechanically resp. loosened by tension and pressure screws.

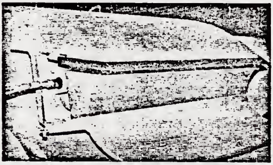
(patent)



③ **KNIFE-CENTRIFUGAL-WEDGE-CLAMPING**

By fast-hydraulic-knife-clamping device.

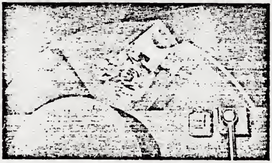
(patent)



④ **KNIFE CENTRIFUGAL-WEDGE-CLAMPING**

By mechanic pre-clamping and automatic clamping (see charact. item A).

(patent)



CHARAC

(A)
SECURED KN

Fast-simple-secured patented
experienced producer of c
turing knife-centrifugal-ke cl

In competition there is n s
clamping to state. This uni in
It practices the optimum clar
round logs and exulting ch
load.

(B)
COUNTER KN

Series-production (whole-less h
patent). This construction le s
the length of chips – importa
particleboard-industry (< r
(>25 mm).

(C)
ROTOR

Heavy robust steel construc
stand of technology. By ex en
hard wood) the wear-parts are xc

ERISTICS

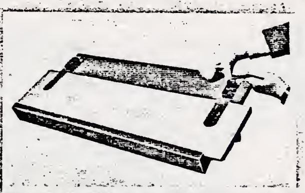
E CLAMPING

ystems. KLÖCKNER is the longest
machines in case of manufac-
ng.

or system of centrifugal key-
olves a problem in processing.
ping especially by the chipping of
ets as a result of infeeds over-

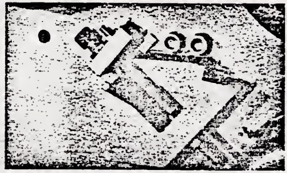
and simple-ideal clamped (applied
fast and easy way of changing
for various chip-suppliers e. g.
or paper- and celulose industry

manufactured to the highest
blems of chipping (aggress or special
eable resp. to be armoured up.



⑤
KNIFE-SETTING-DEVICE

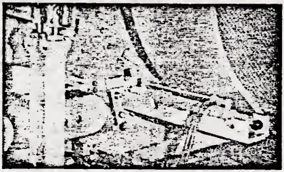
Re. to all systems, shown p. 6, of knife clamping, the adjusting of chipping knife is located outside of the machine.



⑥
COUNTER-KNIFE

Flat-steel (series production) without slots; and wholes, resulting on price and robustness, adjustable for changing the size of chips, four edges, regrindable to 75 %.

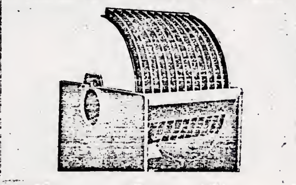
(patent applied)



⑦
COUNTER KNIFE

Removable (in and out) by hydraulics.

Counter knife fixed on a heavy support, moving on glider with no problems.

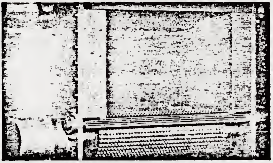


⑧
SCREEN

All screens manufactured by thick walled steel. Under extrem condition (e. g. chipping of trimmings) the screen is welded by longitudinal and cross flange steel.

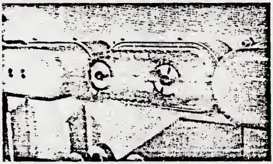
⑨
CRAB ROLLERS

Steel rollers, special teeth, surface finished = wear-resistant. See charact. (D) and text p. 3, rollers with changeable wear-plates when desired.



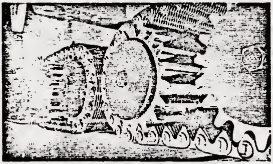
⑩
ROLLER CHAIN-DRIVE

Heavy oversized DIN-chains, reinforced chain rollers, running in oil bath, dustfree, easy accessible by thick metal cover.



⑪
TEETH-CHAIN-DRIVE

Used for extrem big machines by a chipping height of more than 600 mms.



⑫
BEARINGS

All bearing are oversized moving roller bearings, roller cases of steel, centred In machines side walls and secured optimum, see characteristics (F).

CHARAC

(D)
SECURED INF
By KLÖCKNER

Wether operating in summer or winter the KLÖCKNER in-feed-aggregate crabs and transports all forms and sorts of wood. The interlocking teeth

(E)
HYDRAULICS

Stepless adjustable pressure of wood between upper and lower advanced rollers – important for operating in summer and winter – care of roller teeth. Sliding close of upper infeed-aggregate, lift-up of upper

(F)
BEARING OF

The wide centre-ring, turned of, placed on steel-flange cover is integrated into the machines side-wall, therefore absolute

ERISTICS

ED OF MATERIAL

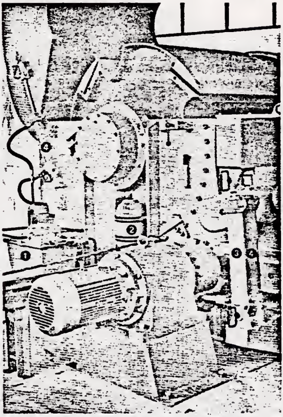
feed aggregate

rollers are self-cleaning, one another. Plugging axises and tension elements guarantee the fast and easy change of rollers.

infeed aggregate, opening and closing of rotor-hood. Counter knife driving in and out. Fast change of chipping knives. If desired, tele-operation to lift-up the upper infeed-aggregate when probably overfeeded.

TORS

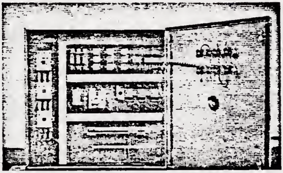
security to the outlifting of the rotor by chipping oversized foreign-bodies. When desired: Installation of a rotor brake.



⑬
HYDRAULICS

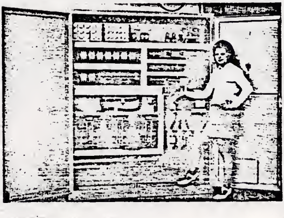
1. Electric pump with oil-box and valves
2. Surge-tank
3. Hydraulic shock absorber
4. Hydraulic cylinder

See **characteristics (E)**



⑭
ELECTRIC INFEED CONTROL

Automatic feed control by main motor, load-dependent. Automatic regulation of infeed = stop and go circuit. Reversable advance. All safety lockings by non-touched limit-switches.



Complete switch plant for main motor by load depending on advance controled motors.

KLÖCKNER TECHN. DATAS of Serie K SHORT-fibered chips

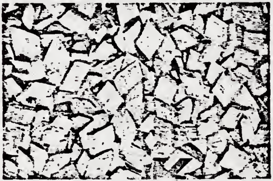
Type: **K T H**	chipping-diameter Ø mm	infeed-capacity * steres	power required ** kW	number of knives piece	rotor Ø mm	weight (net) kg
60 x 140 K - 2 W ***	60 x 140	1	7,5	2	260	470
100 x 300 K - 2 W	100 x 330	3	11 - 22	2	320	580
120 x 400 K - 2 W	120 x 430	5	18,5 - 45	2	470	1430
100 x 300 K - 2 WT (V)	100 x 330	3	11 - 22	2	320	900
100 x 500 K - 2 WT (V)	100 x 530	5	11 - 30	2	320	1160
100 x 650 K - 2 WT (V)	100 x 700	7	18,5 - 37	2	320	1430
120 x 400 K - 2 WT (V)	120 x 430	5	18,5 - 45	2	470	1850
120 x 500 K - 2 WT (V)	120 x 530	7	22 - 45	2	470	2150
120 x 650 K - 2 WT (V)	120 x 700	9	30 - 55	2	470	2600
180 x 400 K - 2 WT (V)	180 x 450	8	37 - 55	2 - 4	600	3800
180 x 500 K - 2 WT (V)	180 x 550	10	45 - 75	2 - 4	600	4200
180 x 650 K - 2 WT (V)	180 x 700	13	55 - 90	2 - 4	600	4800
220 x 400 K - 4 WT (V)	220 x 450	10	55 - 75	2 - 4	760	5700
220 x 500 K - 4 WT (V)	220 x 550	13	55 - 90	2 - 4	760	6200
220 x 650 K - 4 WT (V)	220 x 700	16	75 - 110	2 - 4	760	7000
280 x 400 K - 6 WT (V)	280 x 450	14	75 - 132	2 - 4	1020	6700
280 x 500 K - 6 WT (V)	280 x 550	18	90 - 160	2 - 4	1020	7500
280 x 650 K - 6 WT (V)	280 x 700	22	110 - 200	2 - 4	1020	8900

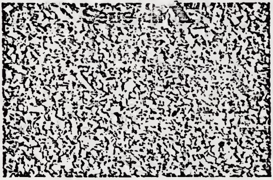
* The a. m. positions are depending on the machines infeed (raw-material) on a basis of fiber length of 4 mms; chip length of 2 - 15 mms by changing of capacity datas. The datas are based on a 15% feed-in of the possible chipping dimensions (chipping height x chipping width)

** Power required can be highered up (reasonable increase of efficiency)

*** Complete supply only with main-motor, 7.5 kW.

1 kg chips, air dried = approx. 3.700 kcl.

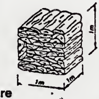




1 stere round-logs

1 stere = 0,75 m^3 = 2 steres chips

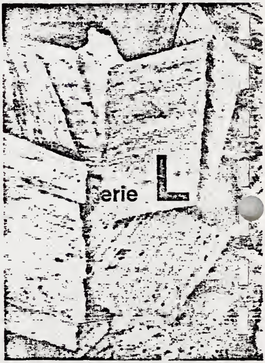
1 m^3 = 1,33 stere = 2,6 steres chips



1 stere slabs

1 stere = 0,6 m^3 = 1,4 stere chips

1 m^3 = 1,66 stere = 2,3 steres chips



KLÖCKNER TECHN. DATAS of Serie LONG-fibered chips

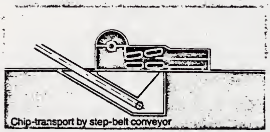
Type: **K T H**	chipping-diameter mm	infeed-capacity * rm/h	power required ** kW	number of knives piece	rotor Ø mm	weight (net) kg
120 x 400 L - 2 WT (V)	120 x 430	17	18,5 - 37	2	470	1850
120 x 500 L - 2 WT (V)	120 x 530	21	22 - 45	2	470	2150
120 x 650 L - 2 WT (V)	120 x 700	27	30 - 55	2	470	2800
150 x 400 L - 2 WT (V)	150 x 430	19	22 - 45	2	520	2200
150 x 500 L - 2 WT (V)	150 x 530	24	30 - 55	2	520	2500
150 x 650 L - 2 WT (V)	150 x 700	31	30 - 75	2	520	3100
180 x 400 L - 2 WT (V)	180 x 450	23	37 - 75	2	600	3650
180 x 500 L - 2 WT (V)	180 x 550	28	45 - 90	2	600	4050
180 x 650 L - 2 WT (V)	180 x 700	36	55 - 90	2	600	4690
220 x 400 L - 4 WT (V)	220 x 450	30	55 - 75	2	760	5500
220 x 500 L - 4 WT (V)	220 x 550	36	55 - 90	2	760	6000
220 x 650 L - 4 WT (V)	220 x 700	42	75 - 132	2	760	6800
280 x 400 L - 6 WT (V)	280 x 450	35	75 - 110	2 - 4	1020	6700
280 x 500 L - 6 WT (V)	280 x 550	43	90 - 132	2 - 4	1020	7500
280 x 650 L - 6 WT (V)	280 x 700	55	110 - 160	2 - 4	1020	8900
270 x 1000 L - 4 WT (V)	270 x 1050	83	132 - 200	2 - 4	1020	9500
360 x 650 L - 8 WT (V)	360 x 700	68	132 - 200	2 - 4	1320	11500
360 x 800 L - 8 WT (V)	360 x 850	83	160 - 250	2 - 4	1320	13400
360 x 1000 L - 8 WT (V)	360 x 1050	102	200 - 315	2 - 4	1320	15300
460 x 800 L - 11 WT	460 x 850	128	250 - 350	2 - 4	1620	21500
460 x 1000 L - 11 WT	460 x 1050	158	315 - 400	2 - 4	1620	23500
460 x 1200 L - 11 WT	460 x 1250	189	315 - 500	2 - 4	1620	26000
460/800 x 1200 L - 13 WT	460/800x1250	200	315 - 500	2 - 4	1620	34000
660 x 800 L - 13 WT	660 x 850	165	315 - 500	2 - 8	2000	31400
660 x 1000 L - 13 WT	660 x 1050	200	315 - 630	2 - 8	2000	34300
660 x 1200 L - 13 WT	660 x 1250	240	400 - 750	2 - 8	2000	37400
850 x 1000 L - 17 WT	850 x 1050	340	400 - 750	2 - 8	2000	56800
850 x 1200 L - 17 WT	850 x 1250	400	500 - 1500	2 - 8	2000	61900
850 x 1400 L - 17 WT	850 x 1450	470	750 - 1500	2 - 8	2000	64100

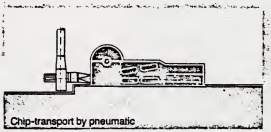
* The a. m. positions are depending on the machines Infeed-capacity (raw material) on a basis of fiber length of 30 mms. The datas are based on 15% infeed of chipping dimensions. Chip length of 15 - 70 mms and longer by change of capacity datas.

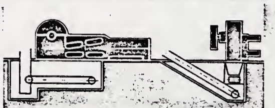
DETERMINATION OF TYPES

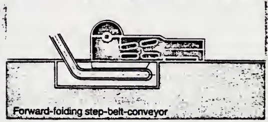
Chipping height on the maximum thickness or diameter of wood to be chipped or piled up material on the transport system. Chipping width depending on the transport system width of the wood. If the required capacit cannot be reached by the type layed out on datas of chipping width and height, we recommend a machine with higher infeed.

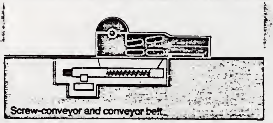
** The fact of required capacity is variable to be highered up. (reasonable increase of capacity).

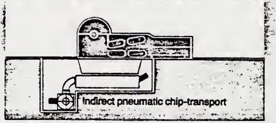

Chip-transport by step-belt conveyor

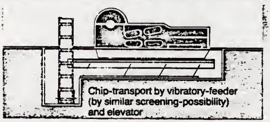

Chip-transport by pneumatic

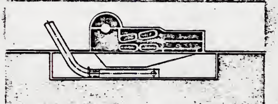

Chip-transport by belt-conveyors


Forward-folding step-belt-conveyor


Screw-conveyor and conveyor belt


Indirect pneumatic chip-transport


Chip-transport by vibratory-feeder (by similar screening-possibility) and elevator


Chip-transport by troughed chain conveyor

We are planning
constructing
producing
installing

Drum-Chippers
Disc-Chippers
Debarkers
Re-Chippers

Chip-Flakers
Chip-Screens
Chip-refining Mills
Belt-Conveyors
Vibratory-Feeders

Cross-Conveyors
Willows
Craddlers
Complete Chipping- and Flaking-Plants

KLÖCKNER

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Phone: 515-832-2157

Presente

Subject

Gebr. KLÖCKNER GmbH
Maschinenfabrik
D-5239 Hirtscheid-Nistertal
Westerwald – West Germany

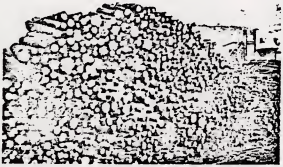
☎ Bad Marienberg (02661) 28–0
8 69 305 kloe d
gekloe nistertal/westerwald

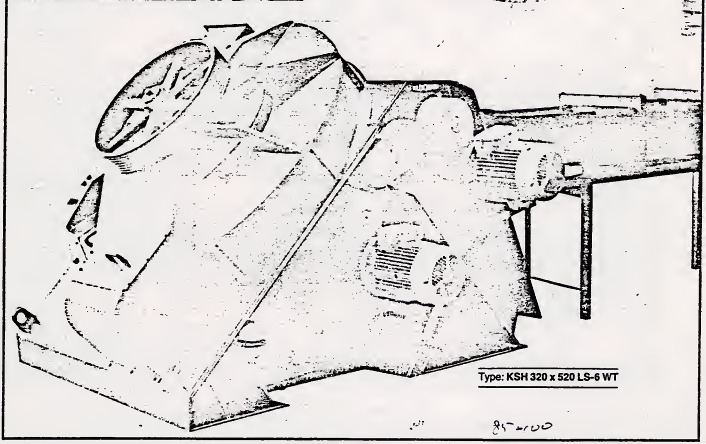
1823000

K Klöckner
S Scheiben
H Hackmaschine

KLÖCKNER
Seit 1897

Disc Chipper





Type: KSH 320 x 520 LS-6 WT

85-100

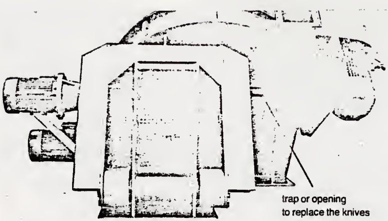
vk. 5.78

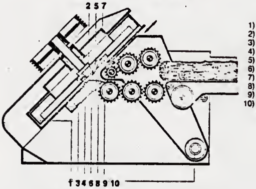
The tried and tested invention from Klöckner

universal claws

The automatic feed, developed by **ourselves** (interlocking feed or grabbing rollers with specially designed teeth) has as of yet not been surpassed.

Thanks to continuous research we are always the first with the best. The upper and graded rollers, together with the lower horizontally arranged rollers, guarantee that the timber is taken to the chipping disc safely and steadily. Upper and lower rollers are driven by two gear motors.



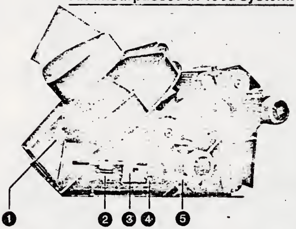


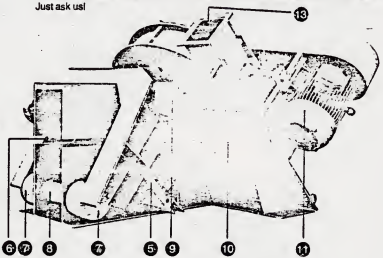
1) ventilated discharging wing
2) exchangeable wear rail
3) anvil
4) counter knife
5) chipping knives
6) chipping table
7) knife clamping plate
8) stripper (exchangeable)
9) stripper (exchangeable)
10) turning point of upper feeding device

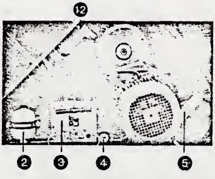
An unsurpassed in-feed system:

The upper and lower feeding system consists of 2 - 8 interlocking, iron-clad rollers, depending on the model.

Contrary to any other technical concept, the turning point is located very deep which offers the optimal solution to avoiding unwanted pieces. Why, how come! Just ask us!







① - air suction channel
② - hydraulic storage
③ - hydraulic pump
④ - pressure-gauge
⑤ - hydraulic cylinder
⑥ - connection for feeding device
⑦ - turning point for upper in-feeder
⑧ - shaft for turning point
⑨ - thick-walled metal boxes for the heavy duty chain drive, running in oil bath
⑩ - trap to replace the knives
⑪ - main drive (upon request)
⑫ - counter knife
⑬ - connecting piece for the discharge

Special Features

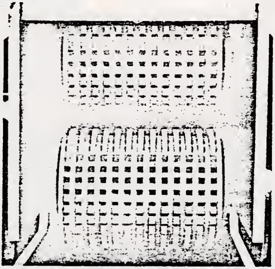
Hydraulic installation (2, 3, 4 and 5):

The hydraulic cylinders on both sides (5) have several functions in connection with the entire hydraulics. The upper grabbing or feeding rollers can be adjusted to the corresponding wood situation (summer and winter) which means the clamping pressure of the upper feeding rollers is infinitely adjustable ± to the wood to be chipped. Simultaneously, the hydraulics cause an even sliding off of the heavy feeding rollers to the zero-position. Moreover, this technical novelty effects to a most careful treatment of the feeding rollers since the clamping pressure, which is only required for the timber feed-in, can be set in advance.

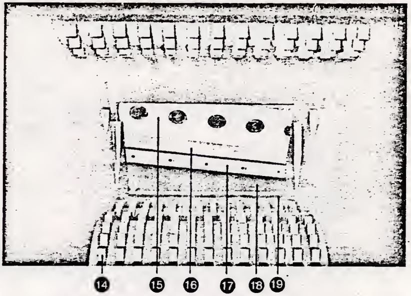
The length of the chips can be adjusted from 15-40 mm (easily and precisely due to KLÖCKNER engineering)

View into the feeding device

closed



open



⑭ iron-clad, grooved rolls

⑮ knife clamping plate

⑯ chipping knife

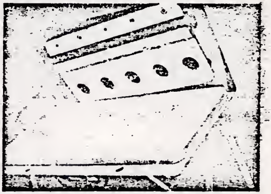
⑰ wear rail

⑱ chipping disc

⑲ counter knife

counter knife and clamping device

opened trap to change knives



Special Features

Counter knife

1. fitting and removing: simple and fast
2. smooth strip knives without any slots = low-priced
3. to be used on four sides
4. 50% regrindable

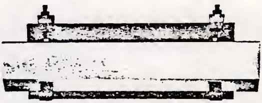
Chipping knife

1. fitting and removing: simple and fast
2. adjustment outside the machine by gauge
3. regrindable more than 40%

Air scavenging system

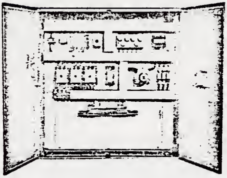
because of a specially arranged air channel (see cover underneath the drive disc) no fine particles within the entire lower machine area.

chipping knife and gauge



These machines have been designed and manufactured, based on many years of experience, in accordance with the latest techniques, in our factory on most modern machine tools, under our policy:

“robust and precise”



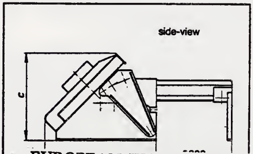
Advance control unit

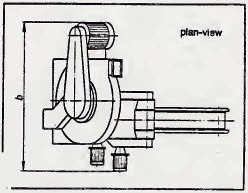
load-depending feed-in control
of the main motor
(standard equipment)

Specification

Type: KSH		180 x 370 L - 2 WT	225 x 420 L - 4 WT	320 x 520 L - 6 WT	400 x 620 L - 8 WT
Entrance width	mm	370	420	520	620
Entrance height	mm	180	225	320	400
*Capacity at feed side	rm/h	12	18	40	80
Power required	kW	30 - 45	45 - 75	75 - 90	132 - 200
Chip length	mm	adjustable from 15-40 mm - easily and precisely due to KLÖCKNER engineering			
Number of knives	pieces	2	2	4	6
Advance speed	m/min	22 - 44	22 - 44	35 ±	35 ±
Disc diameter	Ø mm	1200	1400	1700	2000
Conveyor belt (stand. l.)	m	2	2	2	2
Weight	kgs	3700	5600	8400	10600
Length	a	4100	4400	4800	5300
Width	b	3300	3500	3700	4200
Height	c	1350	1700	2200	2600

* referring to chip length 30 mm





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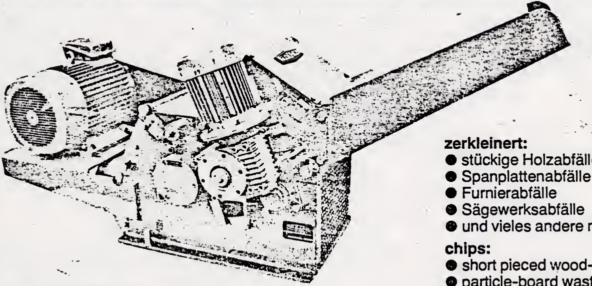
Phone: 515-832-2157

G hinenfabrik
D st-Germany
☎ Joe d ✝ gekloe nistertal/westerw.

subject without obligation

Gebr. KLÖCKNER GmbH & Co.
Seit 1897

HACKMASCHINEN
CHIPPERS · BROYEURS

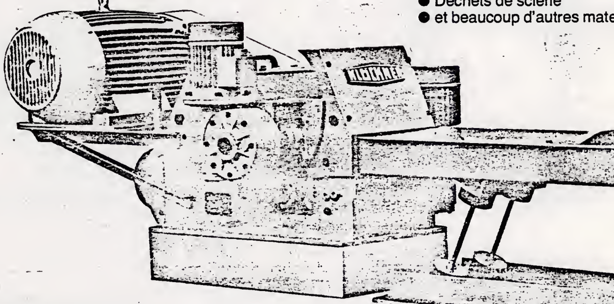


Type: KTH 100 x 300 K - 2 W

zerkleinert:
- stückige Holzabfälle
- Spanplattenabfälle
- Furnierabfälle
- Sägewerksabfälle
- und vieles andere mehr

chips:
- short pieced wood-waste
- particle-board waste
- veneer waste
- saw mill waste
- and many other wastes

broye:
- Déchets de bois en morceaux
- Déchets de panneaux particules
- Déchets de placage
- Déchets de scierie
- et beaucoup d'autres materiaux



Type: KTH 100 x 300 x K - 2 WV

Mit der Serie KTH-100 bietet KLÖCKNER eine vielseitige Baureihe, die außer Massivholz auch Spanplattenabfälle, Furnierabfälle, Laminatabfälle. Packmittel und einiges andere mehr zerkleinert. Die robuste Konstruktion überzeugt nicht nur durch ihre überdurchschnittliche Leistung und Betriebssicherheit, sondern auch durch ihre einfache Handhabung. Je nach Bauart erzeugen die Maschinen Hacklängen von 3 bis 40 mm Faserlänge für Brikettierzwecke und Feuerungsanlagen (K-Typen) oder Industrie-Hackschnitzel (L-Typen) für die Holzplattenindustrie. Die Beschikkung der Maschinen erfolgt je nach Type entweder schräg durch einen Trichter oder horizontal mittels Vibrorinne, alternativ Transportband. Die Entsorgung kann je nach Wunsch mittels Absaugung, Transportband oder Trogkettenförderer erfolgen.

With the series KTH-100, Klöckner offers a multipurposed range, which can handle solid wood and further particle board waste, veneer waste, surfaced waste material, packing material and many other wastes. The sturdy design satisfies not only with an above average production capacity and reliability, but also with simple handling. Depending on type the machines can produce chip lengths between 3–40 mm for briquetting and burning systems K-types) as well as industrial chips (L-types) for particle board industry. Feeding of the machines is effected with oblique infeed resp. horizontal by vibratory feeder or belt conveyor, depending on model. Transport of chips can be effected by a pneumatic system, belt conveyor or chain conveyor.

Avec la série KTH-100, KLÖCKNER vous offre une série de fabrication étendue qui peut broyer en dehors des bois massifs aussi des déchets de panneaux particules, des déchets de placage, des déchets stratifiés, des emballages et plusieurs autres matériaux. La construction robuste n'étonne pas seulement par son rendement au dessus de la moyenne et sa meilleure sécurité, mais aussi par son maniement facile. Selon le type de construction, les machines produisent des copeaux de 3–40 mm longueur de fibre pour le briquettage et des installations de chauffage (types K) ou des plaquettes industrielles (types L) pour l'industries des panneaux en bois. L'alimentation des machines s'effectue selon le type de la machine soit par trémie inclinée ou horizontalement par couloir vibrant ou en variante par tapis transporteur. Le déchargement peut être réalisé selon désir, par aspiration, tapis transporteur ou transporteur en auge à chaines.

£25,000

Klöckner-Trommel-Hacker **Type: KTH**		100 x 300 K-2 W	100 x 300 K-2 WT/V	100 x 500 K-2 WT/V	100 x 650 K-2 WT/V	100 x 300 L-2 WT/V	100 x 500 L-2 WT/V	100 x 650 L-2 WT/V
Hackquerschnitt Infeed height and with Section de broyage	mm	100 x 330	100 x 330	100 x 530	100 x 700	100 x 330	100 x 530	100 x 700
Eingangsleistung Infeed capacity Rendement à l'entrée	m/h	2–4	2–4	3–5	4–6	6–9	8–11	10–12
Kraftbedarf Power required Puissance	kW	11–22	11–22	11–30	18,5–37	11–22	11–30	18,5–37
Messeranzahl Number of knives Nombre de fers	Stück pieces pièces	2–3	2–3	2–3	2–3	2	2	2
Gewicht Weight Poids	kg netto kgs net	650	970	1230	1500	970	1230	1500
Maße Dimensions Mesures	l mm b h	1660 950 910	2885 950 800	2885 1150 800	2885 1350 800	2885 950 800	2885 1150 800	2885 1350 800

Typenerklärung:
K = Kurzfaserige Hacklängen
L = Langfaserige Hacklängen
2W = 2 Walzen (Einzug)
T = Transportband altern.
V = Vibrorinne

Type explanation:
K = shortfibered chips
L = Long fibered chips
2W = 2 feed rolls
T = belt convey
V = vibratory fe

Explication de types:
K = copeaux courts
L = copeaux longues
ion
ariante

KLÖCKNER

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Phone: 515-832-2157

TITLE PAGE

1. Grantee:

Rayson Brothers Logging Company
Route 1, Box 886
Libby, MT 59923
406/293-9306

2. Project Consultant:

David G. Van Hersett, P.E.
Resource Development Associates
West 601 Main Ave, Suite 301
Spokane, WA 99201
509/838-8024

3. Location of Project:

Libby, Montana

4. Funding:

Total Project Cost:	$2,421,510
Amount of Grant:	$ 116,000

5. Project Scope:

The Grantee shall investigate, design and document the feasibility of using forest residue in the vicinity of Libby, Montana, to replace oil and coal as a long-term, cost-effective, dependable energy supply for the vermiculite drying operation at the W.R. Grace and Company vermiculite mine. The Grantee shall research and document basic information including, but not limited to, a site specific data base of wood resources, recovery and combustion technology data, environmental and economic constraints, institutional barriers and interfaces, and the development of specific guidelines for facility sizing for the proposed bioenergy supply and conversion facilities. The Grantee shall develop the conceptual and preliminary engineering designs and cost estimates for all required bioenergy facilities and compare the economics and risks to the present oil facility and to a coal option. The Grantee shall document proven fuel supply systems, fuel supply contracts, permits and licenses, financial, environmental, siting and management requirements. The Grantee shall seek to demonstrate that the proposed energy fuel is a reliable, cost-effecive substitute for coal and oil at the W.R. Grace mine. More specifically, the Grantee shall perform the following tasks that have been organized into a sequence of project milestones. The milestones have been organized to provide the most important information as early as possible so that the study can be terminated if the project does not appear feasible.

INDEX

A. Title Page

B. Abstract/Executive Summary

C. Table of Contents

D. Introduction

E. System Design

F. Economics

G. Grant Administration

H. Results and Conclusions

I. Slide Show Development

APPENDIX

A: Resource Assessment (Tasks 100 to 114)

B: Fuel System Cost performance (Tasks 200 to 202)

C: Economics (Tasks 203 to 214)

APPENDIX A: MILESTONE NO. 1 AND NO. 2 REPORT (TASKS 100 TO 114)

INTRODUCTION

Milestone No. 1 and No. 2 were divided into fifteen separate tasks to provide work packages based on the required manpower requirements. Each task was documented in an individual report. These individual reports were then used to develop the project conclusions and recommendations. Additionally, these individual tasks were used to manage the conduct and progress of the work. The following is a listing of the individual tasks for the Milestone No. 1 and No. 2 Report:

100 Forest Residue Resources

101 15-Year Plan

102 Residue Rights

103 Residue Recovery System

104 Mine Energy Requirments

105 Conceptual Facility Design

106 Bioenergy Economics

107 Coal System

108 Coal Facilities

109 Coal Economics

110 Oil Economics

111 Environmental Assessment

112 Institutional Interface

113 Comparative Economics

114 Management Review

APPENDIX B: MILESTONE NO. 3 REPORT (TASK 200 - 202)

INTRODUCTION

Milestone No. 3 defines the scope of the final phase of the feasibility study. Also, the specific bioenergy system is defined to provide guidelines in the preparation of the final facility design and securing cost quotations from vendors. Milestone No. 3 consists of the following tasks:

200	Revise Tasks Descriptions
201	Design Fuel System
202	Fuel Cost Performance

TASK NO. 200: REVISE TASK DESCRIPTIONS

LIBBY BIOENERGY PROJECT

Activity Schedule

Task Start Date	October 16, 1984
Task Completion Date	October 22, 1984

Personnel Working on Task

Name	Company	Phone
Task Leader		
Dave Van Hersett	Resource Development Associates	509/838-8024
Mike Ray	W.R. Grace	406/293-3746
Howard Haines	State	406/444-6773
Jerrie Little	Resource Development Associates	509/838-8024
Prime Contractor		
Clayton Rayson	Rayson Brothers Logging	406/293-9306
Project Manager		
Dave Van Hersett	Resource Development Associates	509/838-8024

200: Revise Phase II task descriptions to incorporate results of Management Review in Task No. 114.

Product: Revised work statement task descriptions.

A. REVISE PROJECT CONTROL MANUAL

Revise the project activity schedule and each of the Phase II task descriptions. Send to participants for review.

B. DISTRIBUTE PHASE II PROCEDURES MANUAL

Mail task description to all participants. Initiate Phase II work. On October 22, 1984, the Phase II task descriptions were mailed to all participants. The only revision recommended to be changed was the deletion of Task 211 by W.R. Grace & Company. As this recommendation does not impact the state funding, it was forwarded to the state for their concurrance.

RESOURCE DEVELOPMENT ASSOCIATES
DAVID C. VAN HERSETT, P.E.

TO: Libby Bioenergy Project Participants

DATE: October 22, 1984

FROM: Dave Van Hersett Dave

SUBJECT: Phase II Start

Enclosed are the Phase II Task Descriptions that you are involved in. Please review and contact me if you have any questions (Phone No. 509/838-8024)

We are to start new and complete as soon as we can. The objective is to save 1985 for construction activities.

Enclosures

W. 245 SPOKANE FALLS BLVD. • SPOKANE, WASHINGTON 99201 • (509) 747-3079

TASK NO. 200: REVISE TASK DESCRIPTIONS

LIBBY BIOENERGY PROJECT

Activity Schedule

Task Start Date	October 16, 1984
Task Completion Date	October 22, 1984

Personnel Working on Task

Name	Company	Phone
Task Leader		
Dave Van Hersett	Resource Development Associates	509/838-8024
Mike Ray	W.R. Grace	406/293-3746
Howard Haines	State	406/444-6773
Jerrie Little	Resource Development Associates	509/838-8024
Prime Contractor		
Clayton Rayson	Rayson Brothers Logging	406/293-9306
Project Manager		
Dave Van Hersett	Resource Development Associates	509/838-8024

200: Revise Phase II task descriptions to incorporate results of Management Review in Task No. 114.

Product: Revised work statement task descriptions.

A. REVISE PROJECT CONTROL MANUAL

Revise the project activity schedule and each of the Phase II task descriptions. Send to participants for review.

B. DISTRIBUTE PHASE II PROCEDURES MANUAL

Mail task description to all participants. Initiate Phase II work.

TASK NO. 201: DESIGN FUEL SYSTEM

TASK MANAGEMENT INFORMATION

LIBBY BIOENERGY PROJECT

Activity Schedule

Task Start Date	October 22, 1984
Task Completion Date	November 15, 1984

Personnel Working on Task

Name	Company	Phone
Task Leader		
Clayton Rayson	Rayson Brothers Logging	406/293-9306
Dave Van Hersett	Resource Development Associates	509/838-8024
Mike Ray	W.R. Grace	406/293-3746
Jerrie Little	Resource Development Associates	509/838-8024
Ken Briggeman	USFS	406/293-6211
Sam Van Arsdale	Rayson Brothers Logging	509/296-7818
Tom Peck	CPA	406/293-3729
Jerry Parks	USFS	406/293-6211
Ned Dye	Omicron	206/392-0676
Prime Contactor		
Clayton Rayson	Rayson Brothers Logging	406/293-9306
Project Manager		
Dave Van Hersett	Resource Development Associates	509/838-8024

TASK 201 REPORT TABLE OF CONTENTS

1. Introduction
2. Purpose and Task Description
3. Description of Bioenergy Fuel Supply System
4. Sawmill Waste Fuel Supply within 100 miles of Libby, Montana
5. Sawmill Waste Transportation and Preparation Facility Specifications
6. Forest Residue Recovery System Description and Specifications
7. Bioenergy Fuel Handling, Preparation and Storage System Description
8. Conceptual Drawings
9. Bioenergy Facility Bid Specifications Including Facility Performance
10. Budget Quotations from Qualified Suppliers

LIST OF REFERENCES

1983 Directory of Montana's Forest Products Industry, Montana Department of State Lands, Forestry Division, January, 1983.

TASK NO. 202: FUEL COST PERFORMANCE

TASK MANAGEMENT INFORMATION

LIBBY BIOENERGY PROJECT

Activity Schedule

Task Start Date	November 15, 1984
Task Completion Date	December 6, 1984

Personnel Working on Task

Name	Company	Phone No.
Task Leader		
Dave Van Hersett	Resource Development Associates	509/838-8024
Mike Ray	W. R. Grace	406/293-3746
Clayton Rayson	Rayson Brothers Logging	406/293-9306
Jerrie Little	Resource Development	509/838-8024
Sam Van Arsdale	Rayson Brothers Logging	509/926-7818
Tom Peck	CPA	406/293-3729
Ned Dye	Omicron	206/392-0676
Prime Contractor		
Clayton Rayson	Rayson Brothers Logging	406/293-9306
Project Manager		
Dave Van Hersett	Resource Development Associates	509/838-8024

202: Prepare energy conversion facility operations and cost performance specifications for each energy option, forest residues and coal. Prepare conceptual designs and facility specifications. Secure budget quotations from potential suppliers that can provide long-term support in the Libby, Montana area.

Product: For the following major subsystems, prepare conceptual drawings, plan elevation and plat plans. Also prepare bid specifications that include facility performance requirements.

- Fuel Receiving and Handling Systems (see Task 201, Figures 202-4, 202-5, 202-6, and 202-11.)
- Fuel Conversion System bioenergy and coal burners (see Figures No. 202-1, 202-2, 202-3, 202-7, 202-8, 202-9, and 202-10.)
- Emission Control Systems (see Figure No. 202-1, and 202-2)

A: INTRODUCTION

Phase I results dictated that the energy conversion facilities should include the dryer, steam and electric power production. The dry facility is to be a fluid bed combustor-type hot gas generator. A small waste wood fueled cogeneration unit providing both steam and electric power for the mine is to be evaluated.

B: TASK REPORT TABLE OF CONTENTS

1. Introduction
2. Purpose
3. Description of Bioenergy Conversion Facilities
4. Description of Fuel Receiving and Handling Systems
5. Description of Emission Control Systems
6. Conceptual Drawings, Process Diagrams, Heat Balance, Plan/Elevation Drawings and Pilot Plans
7. Bid Specifications with Facility Performance Requirements
8. Budget Quotations: Delivered and Erected

C. LIST OF REFERENCES

(To be completed in final report)

TASK NO. 203: FUEL SUPPLY COST

TASK MANAGEMENT INFORMATION

LIBBY BIOENERGY PROJECT

Activity Schedule

Task Start Date	October 22, 1984
Task Completion Date	November 15, 1984

Personnel Working on Task

Name	Company	Phone No.
Task Leader		
Clayton Rayson	Rayson Brothers Logging	406/293-9306
Chuck Keegan	Consultant	406/293-5113
Mike Ray	W. R. Grace	406/293-3746
Jerrie Little	Resource Development Associates	509/838-8024
Ken Briggeman	U.S. Forest Service	406/293-6211
Sam Van Arsdale	Rayson Brothers Logging	509/296-7818
Tom Peck	CPA	406/293-3729
Jerry Parks	U.S. Forest Service	406/293-6211
Ned Dye	Omicron	206/392-0676
Prime Contractor		
Clayton Rayson	Rayson Brothers Logging	406/293-9306
Project Manager		
Dave Van Hersett	Resource Development Associates	509/838-8024 509/624-2797

203: Prepare fuel supply system operational and cost performance specifications for each energy option, forest residue and coal. Define in detail the fuel resource base reserves. Explore methods to secure rights to obtain bioenergy resources with the forest residue managers. Locate documentation sources that identify the existence of non-used renewable forest residues. Supported with documented experience of currently operating successful forest residue recovery operations combined with the decades of Rayson Brothers logging experience in the Libby area, prepare bioenergy fuel supply system operational and cost performance specifications. Prepare the expected delivery fuel specification. Prepare similar information for the coal option.

Product: Fuel supply system operational and cost characteristics for bioenergy and coal fuels.

INTRODUCTION:

B. TASK REPORT TABLE OF CONTENTS

1. Introduction

2. Task Description and Purpose

3. Define Resource Base for Each Energy Option: Bioenergy, Coal and Oil

4. Secure Commitments from Forest Residue Managers and Sawmills Interested in Being Potential Fuel Suppliers

5. Document Existence of Non-used Renewable Forest Residues That Can Be Used as a Fuel Supply Reserve

6. Document Rayson Brothers Proposed Forest Residue Recovery System. Show Demonstrated Capability of Recovery Systems to Provide For a Reliable Fuel Supply System.

7. Secure Current Coal Supply Data from Supplier. Data Should Include: Coal Specifications, Cost Structure, Term and Contract Conditions

8. Secure Current Coal Transport Data From Contract Haulers. Data Should Include: Cost Structure, Term and Contract Conditions

9. Calculate Fuel Supply System Operational Cost Performance For Bioenergy and Coal Fuels

10. List of Assumptions

C: List of References

TASK NO. 204: FUEL CONTRACT DRAFT

TASK MANAGEMENT INFORMATION

LIBBY BIOENERGY PROJECT

Activity Schedule

Task Start Date	October 22, 1984
Task Completion Date	November 15, 1984

Personnel Working on Task

Name	Company	Phone No.
Task Leader		
Dave Van Hersett	Resource Development Associates	509/838-8024
Mike Ray	W. R. Grace	406/293-3746
Clayton Rayson	Rayson Brothers Logging	406/293-9306
Jerrie Little	Resource Development Associates	509/838-8024
Sam Van Arsdale	Rayson Brothers Logging	509/296-7818
Tom Peck	CPA	406/293-3729
Prime Contractor		
Clayton Rayson	Rayson Brothers Logging	406/293-9306
Project Manager		
Dave Van Hersett	Resource Development Associates	509/838-8024

204: Secure and/or prepare drafts of energy supply agreements between W.R. Grace, Rayson Brothers and the potential coal fuel suppliers. Conduct exploratory contract discussions with the coal supplier and Rayson Brothers Logging Co.

Product: Draft fuel supply contracts.

A. Task Report Table of Contents

1. Introduction
2. Purpose and Task Description
3. Secure Draft Coal Supply Agreement From Coal Supplier
4. Prepare Draft Energy Supply Agreement Between W. R. Grace and Rayson Brothers
5. Prepare Draft Mill Waste Supply Agreement Between Rayson Brothers and Sawmills
6. Prepare Draft Forest Residue Agreement Between Rayson Brothers and Forest Owner or Manager
7. Conduct Preliminary Contract Discussions with Coal Supplier
8. Conduct Preliminary Contract Discussions Between Rayson Brothers and W. R. Grace
9. Conduct Preliminary Contract Discussions Between Rayson Brothers and USFS
10. Revise Draft Fuel Supply Agreements
11. Draft Long-Time Fuel Hauling Contracts

TASK NO. 205: FUEL CONTRACT DRAFT

TASK MANAGEMENT INFORMATION

LIBBY BIOENERGY PROJECT

Activity Schedule

Task Start Date	October 22, 1984
Task Completion Date	November 15, 1984

Personnel Working on Task

Name	Company	Phone No.
Task Leader		
Jerrie Little	Resource Development Associates	509/838-8024
Clayton Rayson	Rayson Brothers Logging	406/293-9306
Tom Peck	CPA	406/293-3729
Prime Contractor		
Clayton Rayson	Rayson Brothers Logging	406/293-9306
Project Manager		
Dave Van Hersett	Resource Development Associates	509/838-8024

205: Prepare all required construction and operating permit applications. Conduct initial planning meetings with all appropriate governmental agencies to evaluate the probability of securing permits when required. Prepare a master time schedule with major milestones depicting the time required to secure each permit. Identify all information requirements to secure each specific permit.

Product: Prepare applications and licensing schedule.

A: Task Report Table of Contents

1. Introduction

2. Purpose and Task Description

3. Systems Descriptions for Energy Source Options

4. Prepare Construction and Operating Permit Applications

5. Conduct Initial Meetings With Appropriate Governmental Agencies

6. Prepare a Master Time Schedule With Major Milestones and Time to Secure Each Permit

7. Identify All Information Requirement for Each Permit

TASK NO. 206: IDENTIFY FINANCING ALTERNATIVES

TASK MANAGEMENT INFORMATION

LIBBY BIOENERGY PROJECT

Activity Schedule

Task Start Date	October 22, 1984
Task Completion Date	December 10, 1984

Personnel Working on Task

Name	Company	Phone No.
Task Leader		
Steve Schaub	J. S. Schaub & Co.	509/838-8978
Clayton Rayson	Rayson Brothers Logging	406/293-9306
Tom Peck	CPA	406/293-3729
Mike Ray	W. R. Grace	406/293-3746
Sam Van Arsdale	Rayson Brothers Logging	509/296-7818
Prime Contractor		
Clayton Rayson	Rayson Brothers Logging	406/293-9306
Project Manager		
Dave Van Hersett	Resource Development Associates	509/838-8024

206: Identify financing alternatives available to energy suppliers and W.R. Grace & Co. The objective is to determine the expected cost of financing all parts of conversion capital systems. Break down the financing costs by major subsystems and the parties expected to finance them. Make both equity and debt sources. Identify likely potential financing methods.

Product: Expected cost of financing by energy subsystem by financing party.

Introduction:

Financing of capital expenditures for the energy options will be assumed to be as follows:

Bioenergy Option:

Forest/sawmill residue recovery and fuel preparation systems to be financed by Rayson Brothers Logging Company. The energy conversion facilities for dryer operation are to be financed by W.R. Grace. The steam and electric production facilities will have two options, W.R. Grace or third party financing.

Coal Option:

Transportation will be assumed to be contracted to contract haulers. The dryer energy conversion facilities will be W.R. Grace-financed. The steam and electric production facilities will have two options, W.R. Grace & Co. or third party financing.

A: Task Report Table of Contents

1. Introduction

2. Purpose and Task Description

3. System Descriptions for Energy Source Options

4. Capital Cost Summary for Energy Source Options

5. Identify Likely Financing Methods for Project Debt and Equity by Third Parties

6. Prepare a Base Case Financing Approach for Rayson Brothers, Third Party and W.R. Grace & Co. to Use in Developing Capital Cost Projections for Their Respective Subsystems

7. Prepare a Financial Model (15 year) to Evaluate the Financial Performance of Each Energy Subsystem

8. Identify Potential Lending and Financing Institutions in Support of Proposed Financing Methods

9. Make Preliminary Contact with Potential Financing Sources and Document Their Interest in Participating in This Project Financing

10. Prepare a Summary of Expected Cost of Financing by Energy Subsystems by Financing Party

TASK NO. 207: ENVIRONMENTAL REQUIREMENTS

TASK MANAGEMENT INFORMATION

LIBBY BIOENERGY PROJECT

Activity Schedule

Task Start Date	October 22, 1984
Task Completion Date	December 10, 1984

Personnel Working on Task

Name	Company	Phone No.
Task Leader		
Jerrie Little	Resource Development Associates	509/838-8024
Mike Ray	W. R. Grace	406/293-3746
Clayton Rayson	Rayson Brothers Logging	406/293-9306
Ken Briggeman	USFS	406/293-6211
Ned Dye	Omicron	206/392-0676
Jerry Parks	USFS	406/293-6211
Prime Contractor		
Clayton Rayson	Rayson Brothers Logging	406/293-9306
Project Manager		
Dave Van Hersett	Resource Development Associates	509/838-8024

207: Prepare the environmental requirements limitations for each energy option. Specifically identify any concerns that may potentially interfere with the orderly development of the project. Define the emission requirements for each emission source by permit. Discuss emission control systems and/or methods to be used to ensure compliance.

Product: Emissions requirements listing by permit for each emission source. Discussion of significant items as identified.

A: Task Report Table of Contents

1. Introduction

2. Purpose and Task Description

3. Energy Options Systems Description

4. Environmental Requirement Limitations for Each Energy Option

5. Identify Major Concerns That May Potentially Interfere with the Orderly Development of the Project

6. Define Emission Requirements by Emission Permit

7. Describe Emission Control Systems and/or Methods to be Used to Ensure Compliance

8. Summary List of Permits for Each Energy Option

TASK NO 208: IDENTIFY SITES

TASK MANAGEMENT INFORMATION

LIBBY BIOENERGY PROJECT

Activity Schedule

Task Start Date	October 22, 1984
Task Completion Date	December 10, 1984

Personnel Working on Task

	Name	Company	Phone No.
Task Leader	Jerrie Little	Resource Development Associates	509/838-8024
	Mike Ray	W. R. Grace	406/293-3746
	Clayton Rayson	Rayson Brothers Logging	406/293-9306
	Ken Briggeman	USFS	406/293-6211
	Jerry Parks	USFS	406/293-6211
Prime Contractor	Clayton Rayson	Rayson Brothers Logging	406/293-9306
Project Manager	Dave Van Hersett	Resource Development Associates	509/838-8024

208: Identify potential site(s) for the energy supply conversion facilities. Selection criteria should include but not be limited to the following:

- Soil conditions foundation
- Accessibility
- Land use zoning
- Utilities such as water and electrical power
- Population density
- Ownership

Product: Site analysis for each site

Introduction:

The sites to be evaluated are as follows:

- Dryer energy conversion facilities next to mill on top of mountain (site A)
- Steam and electrical production site near mine water wells downstream of exising tailing ponds (site B)
- Bioenergy fuel preparation and storage facilities site east of rail loading facilities

These sites were selected based on limited choice of reasonable terrain in the steep valleys in the vicinity of the mine.

A: Task Report Table of Contents

1. Introduction

2. Task Description

3. Site Selection

4. Individual Site Evaluation Data

    - Soil Conditions for Foundation
    - Weather Data
    - Hydrology
    - Accessibility
    - Land Use
    - Utilities: Water, Electric
    - Population Density
    - Ownership

5. Prepare a Preliminary Site Arrangement Showing Major Buildings, Access Roads, Utilities and Energy Conversion Facilities

TASK NO. 209: SITE ENVIRONMENTAL ASSESSMENT

TASK MANAGEMENT INFORMATION

LIBBY BIOENERGY PROJECT

Activity Schedule

Task Start Date	October 22, 1984
Task Completion Date	December 10, 1984

Personnel Working on Task

Name	Company	Phone No.
Task Leader		
Jerrie Little	Resource Development Associates	509/838-8024
Mike Ray	W. R. Grace	406/293-3746
Clayton Rayson	Rayson Brothers Logging	406/293-9306
Ken Briggeman	USFS	406/293-6211
Ned Dye	Omicron	206/392-0676
Jerry Parks	USFS	406/293-6211
Prime Contractor		
Clayton Rayson	Rayson Brothers Logging	406/293-9306
Project Manager		
Dave Van Hersett	Resource Development Associates	509/838-8024

209: Prepare an environmental assessment for each energy facility site. Use the State environmental guidelines and checklist to prepare the environmental data that is available on the Libby area. Identify project. Contact any local environmental organizations and tribal groups that would have potential concerns about the project. Prepare information and make presentations as required to respond to concerns of interested parties.

Product: An environmental assessment for each facility site.

A: Task Report Table of Contents

1. Introduction
2. Site Location Map
3. Description of Energy Conversion Systems by Energy Option
4. Prepare Environmental Assessment for Each Site Using Phase I, Task III
5. Secure Copies of Environmental Baseline Data Such as Weather Data
6. Contact and/or Identify Local Environmental Organizations
7. Document Potential Concerns of Interested Parties

TASK NO. 210: ECONOMIC/RISK ANALYSIS

TASK MANAGEMENT INFORMATION

LIBBY BIOENERGY PROJECT

Activity Schedule

Task Start Date	December 10, 1984
Task Completion Date	December 31, 1984

Personnel Working on Task

Name	Company	Phone No.
Task Leader		
Dave Van Hersett	Resource Development Associates	509/838-8024
Mike Ray	W. R. Grace	406/293-3746
Clayton Rayson	Rayson Brothers Logging	406/293-9306
Ken Briggeman	USFS	406/293-6211
Ned Dye	Omicron	206/392-0676
Jerry Parks	USFS	406/293-6211
Steve Schaub	J.S. Schaub & Co, Inc.	509/838-8978
Jerrie Little	Resource Development Associates	509/838-8024
Sam Van Arsdale	Rayson Brothers Logging	509/296-7818
Tom Peck	CPA	406/293-3729
Prime Contractor		
Clayton Rayson	Rayson Brothers Logging	406/293-9306
Project Manager		
Dave Van Hersett	Resource Development Associates	509/838-8024

210: Prepare comparative economic and risk analyses for the energy options. Compare each energy option to the current oil base case. Use risk items deferred in Task #113.

A: Task Report Table of Contents

1. Introduction
2. Task Description
3. Energy Option System Descriptions
4. Define Economic Data For Each Energy Option
5. Define Risk Analysis Procedure
6. Define Base Line Oil Case
7. Define Variable Factors and Assumptions
8. Prepare Economic and Risk Analysis for Each Energy Option
9. Prepare Comparative Risk Analysis
10. Develop Conclusions and Recommendations

TASK NO. 211: INDEPENDENT REVIEW

TASK MANAGEMENT INFORMATION

LIBBY BIOENERGY PROJECT

Activity Schedule

Task Start Date	December 1, 1984
Task Completion Date	December 31, 1984

Personnel Working on Task

Name	Company	Phone No.
Task Leader		
Dave Van Hersett	Resource Development Associates	509/838-8024
Mike Ray	W. R. Grace	406/293-3746
Clayton Rayson	Rayson Brothers Logging	406/293-9306
Ken Briggeman	USFS	406/293-6211
Ned Dye	Omicron	206/392-0676
Jerry Parks	USFS	406/293-6211
Jerrie Little	Resource Development Associates	509/838-8024
Sam Van Arsdale	Rayson Brothers Logging	509/296-7818
Tom Peck	CPA	406/293-3729
Chuck Keegan	Consultant	406/243-5113
Prime Contractor		
Clayton Rayson	Rayson Brothers Logging	406/293-9306
Project Manager		
Dave Van Hersett	Resource Development Associates	509/838-8024

211: Secure independent review of non-vested third party expert. Identify potential candidates to qualify as non-vested expert. Working with key project participants, select the party to perform an independent review of the project documentation and to render an opinion on the viability of the proposed project.

Product:
- List of expert candidates
- Report by expert

A: Prepare List of Candidates

B: Secure Selection Approval

C: Provide Support to Consultant

D: Secure Report by Consultant

TASK NO. 212: MANAGEMENT REVIEW

TASK MANAGEMENT INFORMATION

LIBBY BIOENERGY PROJECT

Activity Schedule

Task Start Date	January 1, 1985
Task Completion Date	January 31, 1985

Personnel Working on Task

Name	Company	Phone No.
Task Leader		
Dave Van Hersett	Resource Development Associates	509/838-8024
Mike Ray	W. R. Grace	406/293-3746
Clayton Rayson	Rayson Brothers Logging	406/293-9306
Howard Haines	State	406/444-6773
Ken Briggeman	USFS	406/293-6211
Ned Dye	Omicron	206/392-0676
Jerry Parks	USFS	406/293-6211
Jerrie Little	Resource Development Associates	509/838-8024
Sam Van Arsdale	Rayson Brothers Logging	509/296-7818
Tom Peck	CPA	406/293-3729
Steve Schaub	J.S. Schaub & Co., Inc.	509/838-8978
Chuck Keegan	Consultant	406/243-5113
Prime Contractor		
Clayton Rayson	Rayson Brothers Logging	406/293-9306
Project Manager		
Dave Van Hersett	Resource Development Associates	509/838-8024

212: Revise Phase II Management Review - Major Milestones: Prepare results and conclusions to date. Review with key project participants and prepare formal presentation to the W.R. Grace Company management. The objective is (1) to demonstrate beyond any reasonable doubt that the proposed bioenergy fuel is a cost-effective reliable substitute for coal and oil, and (2) to secure approval to W.R. Grace & Company and other parties identified to complete the final phase (Phase III) of the scope of work.

Product: Phase II project development report. Approvals of key participants to complete Phase III.

A: Task Report Table of Contents

1. Introduction
2. Task Description
3. Executive Summary
4. Results and Conclusions
5. Task 201 thru 211 Summaries
6. Phase III Development Plan

B: Prepare Formal Presentations

1. Conduct Key Project Participants Review
2. Prepare Formal Presentation for W. R. Grace

TASK NO. 213: REPORT PREPARATION

TASK MANAGEMENT INFORMATION

LIBBY BIOENERGY PROJECT

Activity Schedule

Task Start Date	January 1, 1985
Task Completion Date	January 31, 1985

Personnel Working on Task

Name	Company	Phone No.
Task Leader		
Dave Van Hersett	Resource Development Associates	509/838-8024
Jerrie Little	Resource Development Associates	509/838-8024
Prime Contractor		
Clayton Rayson	Rayson Brothers Logging	406/293-9306
Project Manager		
Dave Van Hersett	Resource Development Associates	509/838-8024

A: State Report Draft

1. Prepare Phase II Report Draft (Milestones 3, 4, and 5)
2. Submit Report for Review and Comment
3. Revise Draft Report
4. Secure Participants' Approval

TASK NO. 214: STATE REPORT APPROVAL

TASK MANAGEMENT INFORMATION

LIBBY BIOENERGY PROJECT

Activity Schedule

Task Start Date	February 1, 1985
Task Completion Date	March 31, 1985

Personnel Working on Task

Name	Company	Phone No.
Task Leader		
Dave Van Hersett	Resource Development Associates	509/838-8024
Jerrie Little	Resource Development Associates	509/838-8024
Chuck Keegan	Consultant	406/243-5113
Prime Contractor		
Clayton Rayson	Rayson Brothers Logging	406/293-9306
Project Manager		
Dave Van Hersett	Resource Development Associates	509/838-8024

A: State Report Approval

1. Submit Final Report For Approval
2. Revise Report
3. Submit Final Report

TASK NO. 215: STATE CONTRACT COMPLETION

TASK MANAGEMENT INFORMATION

LIBBY BIOENERGY PROJECT

Activity Schedule

Task Start Date	March 1, 1985
Task Completion Date	June 1, 1985

Personnel Working on Task

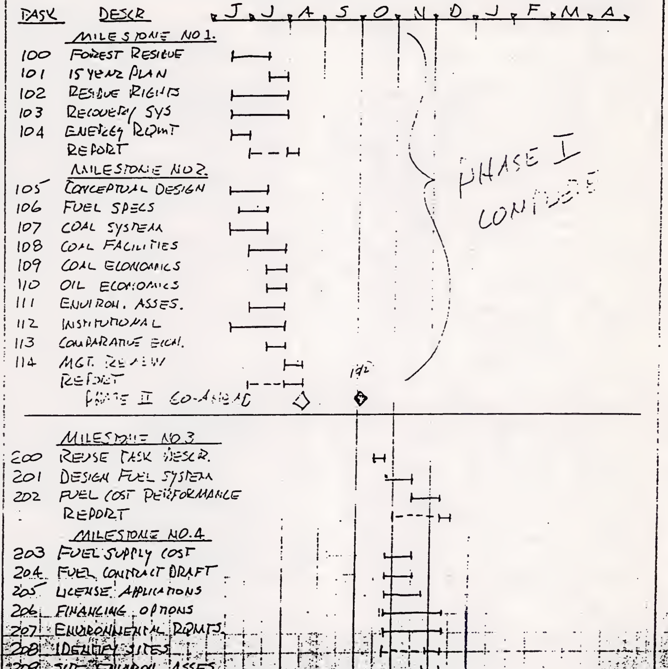
	Name	Company	Phone No.
Task Leader			
	Dave Van Hersett	Resource Development Associates	509/838-8024
	Jerrie Little	Resource Development Associates	509/838-8024
Prime Contractor			
	Clayton Rayson	Rayson Brothers Logging	406/293-9306
Project Manager			
	Dave Van Hersett	Resource Development Associates	509/838-8024

A: State Contract Completion

1. Coordinate with State to Insure All Contract Scope of Work Items Completed
2. Secure Acknowledgement from State That Contract is Complete

IAB E

LIBBY BIOENERGY PROJECT SCHEDULE



TASK	DESCR
	MILESTONE NO 1.
100	FOREST RESIDUE
101	15 YEAR PLAN
102	RESIDUE RIGHTS
103	RECOVERY SYS
104	ENERGY RQMT
	REPORT
	MILESTONE NO 2.
105	CONCEPTUAL DESIGN
106	FUEL SPECS
107	COAL SYSTEM
108	COAL FACILITIES
109	COAL ECONOMICS
110	OIL ECONOMICS
111	ENVIRON. ASSES.
112	INSTITUTIONAL
113	COMPARATIVE ECON.
114	MGT. REVIEW
	REPORT
	PHASE II GO-AHEAD
	MILESTONE NO 3
200	REVISE TASK DESCR.
201	DESIGN FUEL SYSTEM
202	FUEL COST PERFORMANCE
	REPORT
	MILESTONE NO. 4
203	FUEL SUPPLY COST
204	FUEL CONTRACT DRAFT
205	LICENSE APPLICATIONS
206	FINANCING OPTIONS
207	ENVIRONMENTAL RQMTS.
208	IDENTIFY SITES
209	SITE ENVIRON. ASSES.
	REPORT
	MILESTONE NO. 5
210	ECONOMIC/RISK ANALYSIS
211	INDEPENDENT REVIEW
212	MGT REVIEW
213	REPORT
214	STATE REPORT APPROVAL
215	STATE CONTRACT COMPLETION

E0-A2022-3
200-30

TASK NO. 201: DESIGN FUEL SYSTEM

TASK MANAGEMENT INFORMATION

LIBBY BIOENERGY PROJECT

Activity Schedule

Task Start Date	October 22, 1984
Task Completion Date	November 15, 1984

Personnel Working on Task

	Name	Company	Phone
Task Leader	Clayton Rayson	Rayson Brothers Logging	406/293-9306
	Dave Van Hersett	Resource Development Associates	509/838-8024
	Mike Ray	W.R. Grace	406/293-3746
	Jerrie Little	Resource Development Associates	509/838-8024
	Ken Briggeman	USFS	406/293-6211
	Sam Van Arsdale	Rayson Brothers Logging	509/296-7818
	Tom Peck	CPA	406/293-3729
	Jerry Parks	USFS	406/293-6211
	Ned Dye	Omicron	206/392-0676
Prime Contactor	Clayton Rayson	Rayson Brothers Logging	406/293-9306
Project Manager	Dave Van Hersett	Resource Development Associates	509/838-8024

TASK 201 REPORT TABLE OF CONTENTS

1. Introduction

2. Purpose and Task Description

3. Description of Bioenergy Fuel Supply System

4. Sawmill Waste Fuel Supply Within 100 miles of Libby, Montana

5. Sawmill Waste Transportation and Preparation Facility Specifications

6. Forest Residue Recovery System Description and Specifications

7. Bioenergy Fuel Handling, Preparation and Storage System Description

8. Conceptual Drawings

9. Bioenergy Facility Bid Specifications Including Facility Performance

10. Budget Quotations from Qualified Suppliers

LIST OF REFERENCES

1983 Directory of Montana's Forest Products Industry, Montana Department of State Lands, Forestry Division, January 1983.

Task 201: Design Fuel System

1. INTRODUCTION

Phase I results indicated that the bioenergy fuel supply system had to be a combination of hauling sawmill waste in from sawmills in the vicinity of Libby, Montana backed up with fuel produced from forest residues. No fuel from sawmills located in Libby is to be included.

2. PURPOSE AND TASK DESCRIPTION

Finalize bioenergy supply conceptual design and prepare facility specification to secure budget equipment and facility quotations from potential suppliers. Secure budget quotations from potential suppliers. Secure budget quotations from qualified suppliers that can provide long-term support in the Libby, Montana area.

Product: For the following major bioenergy subsystems, prepare a conceptual drawing showing the facility prospective, plan, elevation and plot plan. Also prepare a bid specification that includes facility performance specifications.

1. Forest Residue Recovery System
2. Bioenergy Fuel Preparation System (Figure 202-14, 202-15k and 202-4)
3. Fuel Transportation System
4. Bioenergy Fuel Handling and Storage System (Figure No. 202-4, 202-5, 202-6, 202-11, and 202-14)

3. DESCRIPTION OF BIOENERGY FUEL SUPPLY SYSTEM

The following two charts describe the Bioenergy Fuel Supply System and the Fuel Supply Strategy.

BIOENERGY FUEL SUPPLY STRATEGY

1. Secure long-term waste wood fuel supply commitments from individual sawmills to Rayson Brothers.

2. Contract with W. R. Grace to supply waste wood fuel for a long-term. This allows equipment to be depreciated over a longer term, lowering fuel costs.

3. Rayson Brothers to construct and operate fuel preparation handling and storage yard in vicinity of vermiculite storage and shipping facilities. Refer to Site C, Figure 202-11.

4. W. R. Grace & Co. to install bioenergy conversion facilities at mine.

5. Contract hauling of fuel with established haulers.

6. Develop forest residue and logging back-up fuel supply system. Secure contracts for forest residues with timber stand owner/managers. Establish agreements with local loggers to secure forest residues as needed for back-up fuel supply.

4: SAWMILL WASTE FUEL SUPPLY WITHIN 100 MILES OF LIBBY, MONTANA

INTRODUCTION

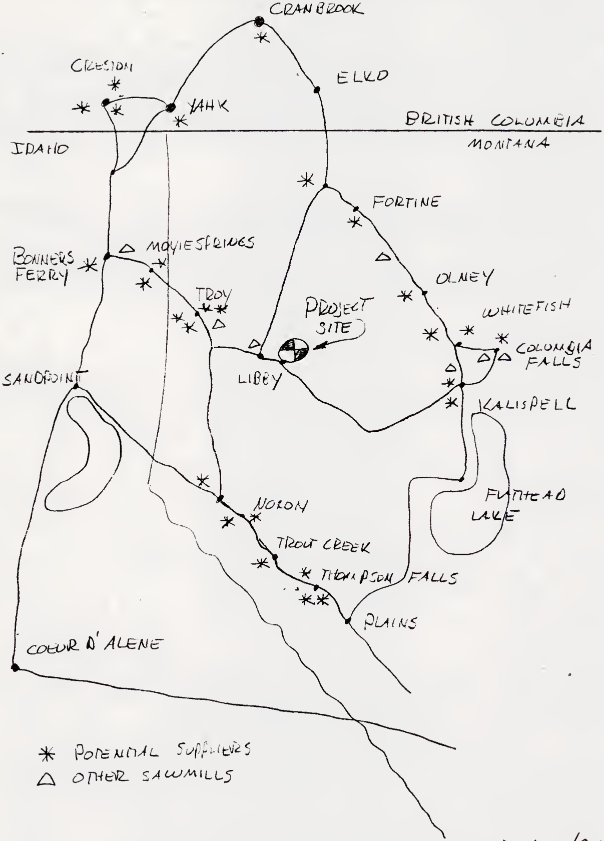
The week of October 20/31, 1984, a survey of 27 sawmills in a 100-mile hauling distance of Libby was conducted. At each mill, the mill owner or superintendent was interviewed. After an explanation of the Libby Bioenergy Project, the mill owner was asked if he was interested in being a fuel supplier. He was then asked for an estimated total of the annual fuel quantities that were produced at his sawmill.

CONCLUSION

The fuel survey results indicate that there is sufficient sawmill wood waste available to meet the energy requirements of the W. R. Grace & Co. vermiculite mine.

The results of the mill waste wood survey are summarized on the following pages.

POTENTIAL FUEL SUPPLIERS



DUH 11/84

MILLWASTE SURVEY RESULTS

Number Sawmills	Annual Tons Mill Waste	Committed Fuel	Maybe	Interested
Number of Sawmills in Lincoln, Sanders & Flathead Counties				
58	484,200 tpy	Source: 1983 Montana Directory		
Total Number of Sawmills Surveyed				
27	402,975	127,500	77,250	198,225
Sawmills within 100 miles				
26	312,975	127,500	77,250	108,225

Sawmill Waste Specification (14 Potential Suppliers)

Classification:	Bark	Sawdust	Slab	Chunks	
Size:	Less than 6 inches	Greater than 1/2 inch	Greater than 6 inches	Greater than 3 inches	Sub Total
Cedar	-	4%	5%	3%	12%
All other specie:	29%	46%	4%	9%	88%
Subtotal	29%	50%	9%	12%	100%

Note (1): Does not include 60,000 tons mill waste pile

1983 DIRECTORY OF MONTANA SAWMILLS

(NUMBER OF SAWMILLS)

County	A	B	C	D	E	F
Flathead	29	1		2	2	1
Lincoln	7		1		1	1
Sanders	10			2	1	
	46	1	1	4	4	2

Sawmill Classification — Annual Mill Waste Production Estimate
1.2 tons per mbf.

A = 46 mills x 2,000,000 bt x 1.2 ton/1000 bt = 11,400 tons

B = 1 mill x 4,000,000 bt x 1.2 ton/100 bt = 4,800

C = 1 mill x 7,500,000 bt x 1.2 ton/1000 bt = 9,000

D = 4 mills x 17,000,000 bt x 1.2 ton/1000 bt = 81,600

E = 4 mills x 33,000,000 bt x 1.2 ton/1000 bt =158,400

F = 2 mills x 50,000,000 bt x 1.2 ton/1000 bt =120,000

58 mills — 484,200 tons/yea

TASK 201,5: SAWMILL WASTE TRANSPORTATION AND PREPARATION FACILITY SPECIFICATIONS

INTRODUCTION

In order to prepare a sawmill waste wood specification, the sawmill waste wood from each sawmill surveyed was characterized by specie and size. Two specie classifications were used: cedar and all other specie. The size classifications used are less than one inch, less than six inches and greater than six inches. The results of the survey are presented below.

Transportation of the waste wood will be in standard chip vans. The sawmill will load the chip vans with their mill waste as produced. No hogging will be required by the sawmills. The mill waste will be transported to Libby for hogging, processing and storage.

In order to protect the sawmill's proprietary data, the survey transportation costs are summarized in the following table:

Mill Waste Transportation Cost

Number of Mills	Annual Tons Hauled	Annual Transportation Cost	Cost/Ton
13	168,275	$1,585,100 (1)	$9.42

Note (1): Assume 24 tons average loads, $30 to load and unload and $0.95 per truck mile.

Mill Waste Size Specification

Specie (2)	Bark (3)	Sawdust (4)	Slabs (5)	Chunks (6)	Total
Cedar	-	4%	5%	3%	13%
All other Specie	28%	46%	4%	9%	87%
Total	28%	50%	9%	12%	100%

Note (2): Specie processed in survey area: Douglas Fir, Idaho White Pine, Western Red Cedar, Ponderosa Pine, Lodgepole Pine, Englemann Spruce, White Fir, Western Larch and Western Hemlock.

Note (3): Bark will be considered as less than six inches in size. It is produced from debarking machines and contains 80 percent bark and 20 percent white wood.

Note (4): Sawdust size distribution is 100 percent less than 1/2 inch in size.

Note (5): Slabs will be the product from small rough cut sawmills and cedar board sawmills. The slab will usually be a maximum length of eight feet, 3 to 15 inches in width and up to 4 inches total thickness. The slab will be normally 50 percent bark and 50 percent wood.

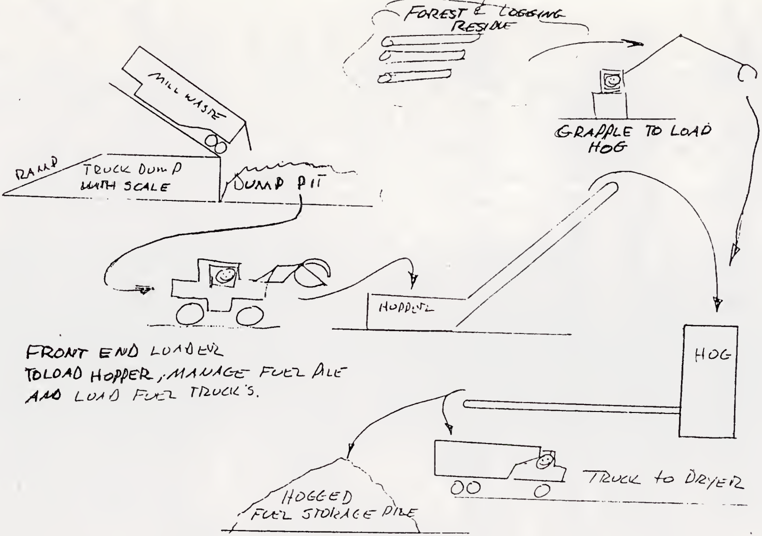
Note (6): Chunks will be several categories:

a. Trim from boards varying from 3 to 6 inches in thickness and up to 4 feet long with an average length of 8 inches,

b. Log ends from log trimming averaging 8 to 10 inches in diameter and 2 inches in thickness,

c. Cedar chunks ranging in size up to 3 feet long by 3 feet in diameter, and

d. Occasional unusable logs up to 8 feet long and 12 inches in diameter.



FUEL HANDLING AND STORAGE YARD

The sawmill waste wood will be loaded into standard chip vans at the sawmill. The waste wood will be hauled to the Rayson Brothers fuel yard for unloading and sizing prior to placing in storage. The selection of the waste wood hogging equipment has been narrowed to two machines: (1) a horizontal knife hog or (2) a universal refiner. Both hogs have proven performance and slightly different operating features. These two machines are described on the following pages.

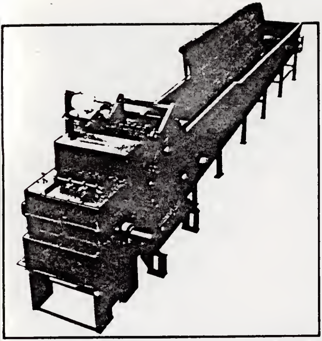
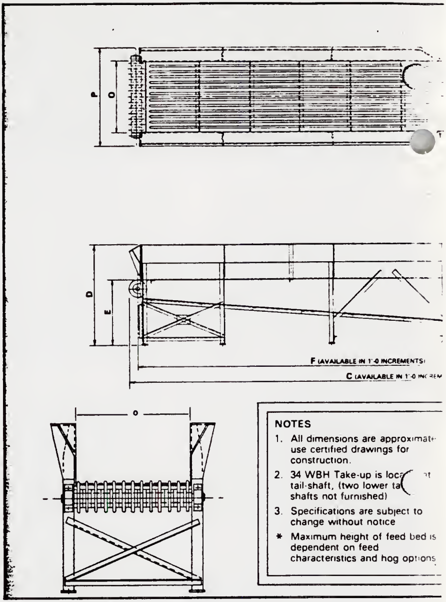


Photo #4

EFFICIENT, ECONOMICAL WASTE RECOVERY...

Greater dependence on woodlands and industrial residuals as energy resources, in the last decade, as well as economic and environmental concerns in preceding decades resulted in the need for a super-heavy duty wood hog to handle increasingly difficult jobs.

The Jeffrey Horizontal Hog takes rough, tough woodwaste of unusually large dimension and reduces to boiler feed size in a single pass. Installations from the Redwood forests of the West to the pulpmills of the East...from the tropical rainforests of the Philippines to the snowy North Woods evidence Jeffrey's APPLICATION EXPERIENCE.



NOTES

1. All dimensions are approximat use certified drawings for construction.
2. 34 WBH Take-up is loc[illegible] tail-shaft, (two lower ta[illegible] shafts not furnished)
3. Specifications are subject to change without notice

* Maximum height of feed bed is dependent on feed characteristics and hog options

Horizontally Fed Hog Applications

Jeffrey is the most recognized name among wood hogs in the world today...and how has Jeffrey earned that reputation? Over 50 years of application and design experience has evolved the most durable hogs with the lowest operating costs.

The rugged Jeffrey Wood and Bark Hog was engineered to accept a side feed well over a decade ago. This was accomplished by revising the standard hog, then integrating a live chain feed table and feed control mechanism. This hogging system is capable of accepting wood scrap/bark, whole trees and/or industrial refuse. Surge shutdowns have been practically eliminated.

The horizontal hog is most often specified for the reduction of especially tough, stringy, moist or fibrous wood bark materials, as well as material that is too wide or long or causes surges in the conventional, top-fed hog. Tough bark applications such as Redwood bark, Cedar bark and Hemlock bark; as well as tops, reject logs, lily pads, butt ends, slabs, edges, trim ends and yard clean-up are typical material feeds. General industrial refuse such as ceiling tile, paper, and polyethylene sheeting are common applications. Hogged material is most often used as fuel but may be used in the preliminary production of particle board and other building materials.

The fuel produced from hogging operations has found favor due to its high combustibility and low ash residue. Clean-up and disposal of wood and industrial residuals has been made more manageable due to the easily handled, hogged product.

While a wide range of sizes and infeed capabilities is available, a smaller hog is normally specified due to the lack of necessity to size for surges. Smaller hog requirements reduce initial system cost, engineering cost and effect lower operating costs due to lower horsepower requirements.

JEFFREY DRESSER

JEFFREY

HORIZONTAL WBH HOG

WITH PATENTED HOLDDOWN FOR POSITIVE FEED

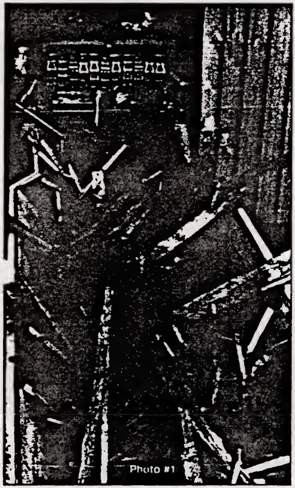


Photo #1

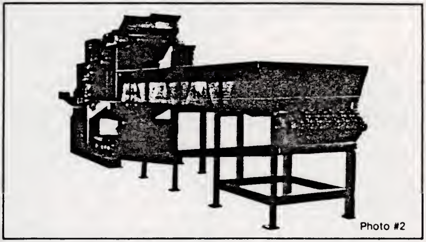


Photo #2

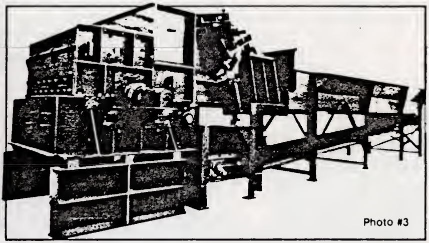


Photo #3

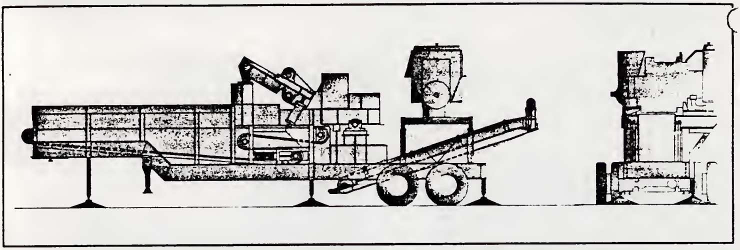
The World's NUMBER ONE WOOD HOG
Can Take It. . . Lying Down

- REDUCES WET, STRINGY BARK WITH EASE
- ACCEPTS LARGE, MIXED DIMENSIONS (TREE TOPS, LONG PIECES)
- SURGES CONTROLLED BY EXCLUSIVE POSITIVE FEED
- REDUCED MAINTENANCE AND DOWNTIME
- OPTIMIZES HORSEPOWER REQUIREMENTS

RADER COMPANIES, INC.
P.O. Box 20128
Portland, OR 97220

LITERATURE #25084

Field Conversion of Residue to PROFIT



Jeffrey Portable Hog for Heavy Duty Cleanup

The Jeffrey Portable Horizontal Hog consists of the complete hogging system described previously, mounted on a custom flatbed trailer with an inclined belt conveyor included. The portable system facilitates field hogging of clear cut cleanup, storm damage cleanup, orchard trimming operations and general cleanup of wood and fibrous materials residue. Awkward, oversized residue is easily handled. Transportation costs are reduced by movement of the hogging operation to the site.

PHONE OR WRITE FOR COMPLETE DETAILS

Jeffrey Manufacturing Division
Dresser Industries, Inc.
Processing Products
P.O. Box 387
Woodruff, South Carolina 29388
Phone (803) 476-7523

In Canada:

Jeffrey Manufacturing Division
Dresser Canada, Inc.
P.O. Box 700, LaSalle, P.Q. H8R3Y4
Telephone (514) 366-2550
Telex: 055-66144

OR YOUR LOCAL JEFFREY REPRESENTATIVE

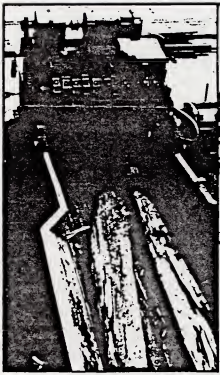


Photo #6

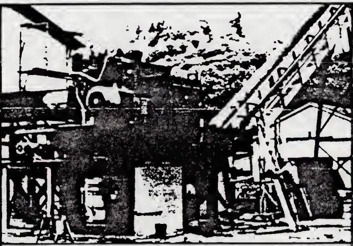


Photo #7

PHOTO LEGEND

Photo #1	**No. California Installation, Mixed Feed**
Photo #2	**Model 45 WBH**
Photo #3	**Model 76 WBH**
Photo #4	**Model 56 WBH**
Photo #5	**Positive Feed Components, Model 45 WBH**
Photo #6	**No. California Installation, Large Infeed**
Photo #7	**No. California Installation, Plant Site**
Photo #8	**Model 56 WBH**

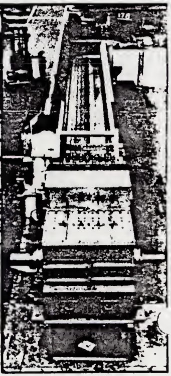
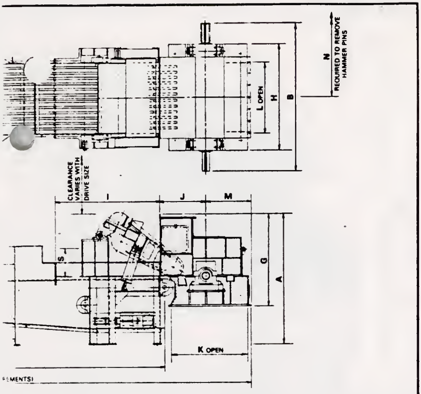


Photo #8


REQUIRED TO REMOVE HAMMER PINS
N
B
H
L OPEN
CLEARANCE VARIES WITH DRIVE SIZE
I
J
M
S
G
A
K OPEN
EMENTS)

DIMENSIONS IN INCHES																	
SIZE	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	S
VBH	48	74	232	32	16	176	30	54	56	24	35	33	48	60	32	46	*
WBH	105	91	283	74	53	210	72	64	90	32	52	43	48	74	41	64	*
56 WBH	120	116	306	94	63	216	84	82	96	42	71	56	60	96	53	80	*
58 WBH	120	136	306	94	63	216	84	98	96	42	71	63	60	112	64	90	*
68 WBH	124	141	327	94	63	216	94	113	96	50	80	63	60	112	64	90	*
76 WBH	133	160	360	94	63	252	114	97	132	55	85	56	60	101	53	80	*

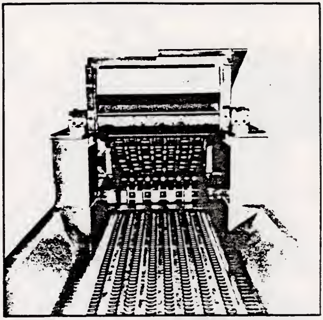


Photo #5

EXCLUSIVE POSITIVE FEED CONTROL

Positive feed control is achieved by downward pressure of the patented, overhead-pivoted, inclined holddown, combined with the positive conveying motion of the live deck. The holddown automatically reacts to variances in material depth. The combined gripping action of the holddown and the live deck effects a positive feeding action.

Variances in material size and texture are accomodated by manual and automatic controls which are used to coordinate variances in holddown, chain and hog motor speed.

Operation and Components

All the benefits of toughness and economy inherit in the conventional hog are present in horizontally fed models. A full explanation of the top-fed hog appears in the Wood and Bark Hog catalog but a review of features includes: (1) tough, heavy plate construction (2) easily removed and replaced, wear liners (3) alloy steel hammers attach to a statically and dynamically balanced rotor (4) integral metal traps are easily accessed through "quick-open" covers. With all these features it's easy to understand why the Jeffrey hog lasts longer and reduces operating costs.

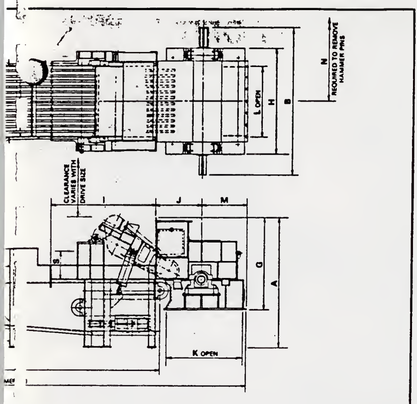
An operational review of the feed table and holddown appears above. Full details are available from your Jeffrey representative.

REQUIRED COMPONENTS

- Jeffrey Hog
- Jeffrey Feed Holddown
- Jeffrey Live-Feed Bed
- Hog Motor
- Jeffrey Holddown and Feed Table Drives and Controls

OPTIONAL EQUIPMENT

- Structural Hog-Motor Base
- Bearing Vibration Monitor
- Bearing Temperature Monitor
- Oil Circulating System


N
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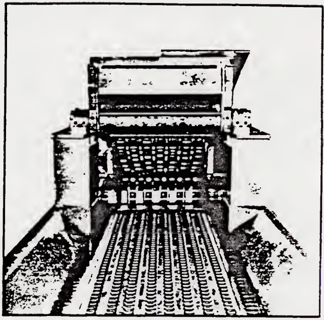
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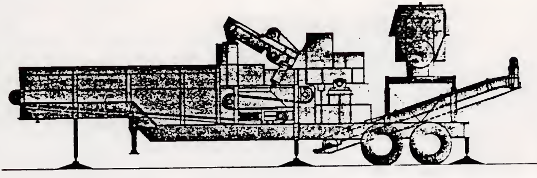
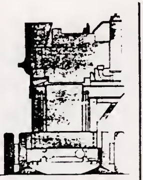
Field Conversion of Residue to PROFIT





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Telephone (514) 366-2550
Telex: 055-66144

OR YOUR LOCAL JEFFREY REPRESENTATIVE

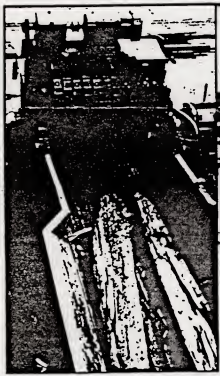

Photo #6

Photo #7

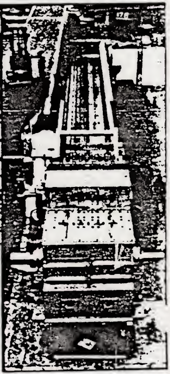

Photo #8

PHOTO LEGEND

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UNIVERSAL REFINER (HOG)

MISCELLANEOUS DATA

Contact Dick Hall: 206/249-4415 (office)
206/532-1500

USERS:

- * HALCO FENCE AND WIRE: Port Townsend, EA
  Jerry Short: 206/385-2004
  3" dia opening, 200 HP, Produces 6 truck loads (13 units) per shift Cedar Slabs, Log Ends, Mill Waste
- * WEYERHAUSER, Philadelphia, Miss.
  Bob Osburn 601/656-5300
  42" dia opening, 300 Hp 7 days/week/3 shifts
  Wood Yard Clean-up

OPERATING DATA

* Power use/ton = $\frac{200000 \text{ kwthr/month}}{2500 \text{ tons/month}}$ = 8 kwhr/ton

---

Sizing (careful use of the following could be understated)

- 2 loads/day (10,000 tons/year = 2-5 50 HP motors - $ 60,000)
- 3 loads/day (15,000 tons/year 2-125 HP motors - $110,000)

UNIVERSAL REFINER CORPORATION

October 5, 1984

N.W. Co-Generation
W. 601 Main Street
Suite 301
Spokane, WA 99201

ATTN: MR. DAVE VAN HERSETT

Dear Dave,

Enclosed are several brochures per your request in our telcon of todays date. We are in the process of printing up new brochures, and will forward some to your attention when these are completed. Also enclosed is a snapshot of the large Universal Refiner weighing in excess of 70,000 lbs., and infeed conveyor used to service that machine prior to being shipped to New Jersey.

The following is a partial list of Universal Refiner Corporation customers:

Weyerhaeuser Company - Philadelphia, MS

· Quinault Cedar Products - Neilton, WA

Boise Cascade Paper Group - Rumford, ME

· Halco Fence & Wire - Port Townsend, WA

Thompson Lumber - Ailey, GA

A 60" Universal Refiner will be shipped next month to the US Army Supply Depot in Texarkana, TX. This machine will serve to provide fuel for their new steam plant, and will primarily be used to grind pallets and other similar material.

A similar machine will be shipped to Potlatch Corporation in Cloquet, MN sometime in December. This machine will be used to grind poplar chunks and stringy bark.

If further information is required, or a meeting is desirable to further discuss the Universal Refiner, please advise.

Yours very truly,

UNIVERSAL REFINER CORP.

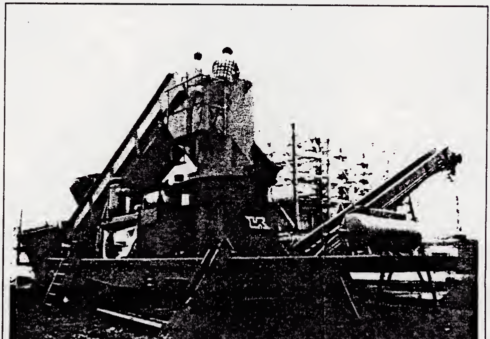
Richard W. Hall

Richard W. Hall
Vice President of Sales

MONTE SQUARE • P.O. BOX 203 MONTESANO, WA 98563 TELEPHONE (206) 249-4415

206-532-0620 (Hm)

COMMINUTING FOREST RESIDUE, MUNICIPAL/INDUSTRIAL WASTE FOR PROFIT.



UNIVERSAL REFINER

THE UNIVERSAL REFINER...

THE MOST EFFICIENT & ECONOMICAL WASTE REDUCTION SYSTEM FOR:

- ★ Wood Waste
- ★ Saw Mill Waste
- ★ Log Yard Waste
- ★ Pallet Reduction
- ★ Logging Residue
- ★ Cut Shop Waste
- ★ Paper Products & Cores
- ★ Plywood Waste
- ★ Pressboard Waste
- ★ Municipal Waste
- ★ Railroad Tie Reduction

Front cover

Transportable Universal Refiner shown at Murray Pacific, Tacoma, Wa. The trailer mounted, diesel driven model comes complete with infeed conveyor, outfeed conveyor and hydraulic power system. The unit is used for producing boiler fuel from tree limbs, tree tops, bark and other waste wood at log sorting yards, at logging operation landings and areas where electrical power is not available. The infeed system is hydraulically tilted for highway transportation.

A state-of-the-art machine that has proven the most efficient and economical way to comminute (shred, grind, pulverise) wood residue, cedar bark, redwood bark, large pieces of wood of any species, tree branches, stumps, paper products, paper cores and municipal garbage. It gets its name because of this versatility in reducing waste material for fuel and recycling uses.

What makes the Universal Refiner so unique is that unlike hogs, there are no hammers, knives and anvils to break or wear out. The Comminuting is accomplished by centrifugal force and rolling penetration action, with the greatest stress being on the material being processed rather than the machine.

The Universal Refiner operates at relatively low constant power level and in most cases can be fully loaded with material prior to being started. Particle size is controlled through a screen disc that can be quickly changed to produce material of the desired size.

Infeed openings presently range in size from 26" to 62" diameter. Larger openings available on special order.

Weight ranges from 15,000 lbs. on the small Universal Refiner to 100,000 lbs. for the big models. The stationary model with 26" opening pictured, weighs 15,000 lbs. Universal Refiners do not require a heavy foundation, and, as an added option, they are ideally suited for portable use in the yard or remote site, mounted on a trailer with diesel power (as shown in the other illustration)

Universal Refiner Corporation . . .

TRANSPORTABLE.

STATIONARY.

UNIVERSAL REFINER Specifications:

Benefits:

- ★ No hammers, knives or anvils to break or wear out. Less downtime.
- ★ Much lower horsepower requirements. Big energy cost savings.
- ★ Portable or stationary models. Wide range of infeed openings 26-96".
- ★ Fast control of particle size through easily changed screen disc.
- ★ Operating unhampered by tramp metal and rocks. Big savings in downtime and parts.
- ★ A unique comminuting machine which refines cedar bark, redwood bark, large pieces of wood of any species, tree branches, stumps, rocks, soft metals, paper products, paper cores and municipal garbage. It got its name because of this versatility.

20 SERIES:

Infeed openings: 26-46"
Horsepower : 125-600 hp
Weight : 14,000-65,000 lbs.
Height* : 8'8" to 12'8"

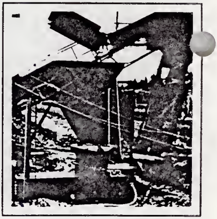
24 SERIES:

Infeed openings: 34-62"
Horsepower : 150-700 hp
Weight : 17,000 to 78,000 lbs.
Height* : 8'8" to 12'8"

- *On portable models the infeed system is hydraulically tilted for highway transportation*
- *Special large opening Universal Refiner for pallets*

Stationary Universal Refiner (not bolted to floor) shop testing spruce limbs and log ends. Model series 24 has 41" opening.

Tramp metal that was removed from the Universal Refiner without breaking the machine or causing downtime.



Universal Refiner series 20 with 33" opening replaced this 60' diameter Wigwam burner — converting a liability to an asset.

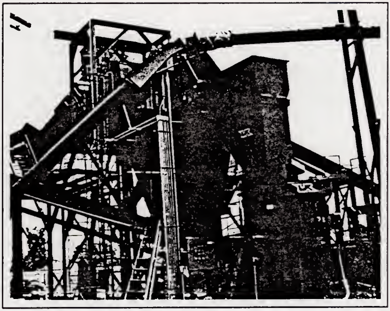
“*Eventually I knew the waste wood stored in my yard over years would be worth money. The Univeral Refiner has been working for months virtually non-stop producing a steady 8 to ten truck loads of wood fuel a day with almost no maintenance.*”
DON COOK, OWNER
PRECISION PRODUCTS INC.
CAPALIS CROSSING, WA.

“*We like the versatility and efficient operation of the Universal Refiner. It can be used for making landscaping mulched bark one minute, then quickly converted to produce boiler fuel from mill yard waste the next.*”
TAL EDMAN,
OWNER/CONTRACTOR
EDMAN COMPANY,
TACOMA, WA.

WHAT THEY SAY ABOUT THE UNIVERSAL REFINER.

“*My customer (a large pulp mill) says our hog fuel is the best he can get. We're more than satisfied with the Universal Refiner.*”

ROY HANSEN
OWNER
QUINAULT CEDAR PRODUCTS
NEILTON, WA.



Universal Refiner 24 Series with 41" opening at Weyerhaeuser Philadelphia, Mississippi.

Patented. #4,366,928
Other Patents Pending.

Universal Refiner Corporation

P.O. Box 203
Montesano, Washington 98563
206-249-4415

6: FOREST RESIDUE RECOVERY SYSTEM DESCRIPTION AND SPECIFICATIONS

INTRODUCTION

The recovery of forest residues using feller-bunchers and grapple skidders has an established performance record here in the Pacific Northwest. In order to select the most cost effective recovery system, Rayson Brothers visited several forest residue recovery operations. The field trips documented in the Appendix A. The conclusions are: One: The volume of material recovered must utilize equipment to its capacity. Two: Forest residue operation must be integrated with traditional saw log and pulp log recovery operations to share common recovery costs such as road access, landing preparation, staff transportation and equipment maintenance.

The grapple skidder and the feller bunchers have gone through several levels of improvement in the last decade. Equipment now is more reliable and has steadily increased production capabilities. A recent illustration of this is shown on the following brochure describing a clambunk skidder. Note the increased production capabilities and the impact the machine has on recovery practices and costs. This machine appears to be the best machine to recover forest residue in the Libby area.

Residue Recovery Systems Description

Rayson Brothers have selected two alternative Residue Recovery Systems based on the fuel production rate and the state of the local timber harvesting market. Using the long-term assumption that the St. Regis sawmill complex in Libby will continue to have a stable operation, forest residue will be available at an incremental cost which will be dependent upon the harvesting practices of the logger. Discussions with independent gypo loggers in the Libby area indicate that they will probably haul logging residue into the fuel preparation yard for $300 to $400 per load plus transportation cost. This alternative system does not require Rayson Brothers to invest in specialized forest residue recovery equipment at the outset.

Direct forest residue recovery operation by Rayson Brothers will require the following minimum production rates:

. Annual tonnage	75,000 tons per year
. Term of production	5 years

These production specifications allow Rayson Brothers to establish a cost effective operation to produce a bioenergy fuel for $30 per ton. The system equipment listing and performance specifications are as follows:

CHIPPING AT PLANT: OPTIMUM EQUIPMENT PERFORMANCE
(72,000 TONS/YEAR)

2 JD 540 G/S	@ $101,000	$202,000	
1 BC F/B		80,000	
2 JD 500 Crawler w/FB	@ $94,000	188,000	
1 MB 22 WTC		138,000	
1 MB 20 WTC		65,000	
1 JD 540B G/S (Used)		60,000	
1 JD 550 Crawler Blade (Used)		40,000	
			$773,000
1 JD Forklift		150,000	
1 MB 3 whl G/S		65,000	
			$998,000
1 1 Ton 4 WD Crew Cab		14,500	
1 3/4 Ton 4 WD P/U		11,800	
1 1/2 Ton 4 WD P/U		10,000	
2 Chain Saws	@ $750	1,500	
1 Welder, Torch, Woods Tools		4,000	
1 HD Tool Set		3,500	
1 Parts/Supplies Inv.		5,000	
			50,300
Office Equip/Supplies		5,500	
	Total		$1,043,800

MONTHLY OPERATING COSTS

CHIPPING AT PLANT: OPTIMUM EQUIPMENT PERFORMANCE (72,000 per year)

Equipment-Production		
Labor - Direct (11/22) @ $13.00	$42,900	
Labor - PR Taxes (30%)	12,870	
Labor - Fringe (5%)	2,145	
Diesel	13,200	
Gas	150	
Repairs-Maint.	14,654	
Parts-Supplies	7,327	
Insurance-Liab. & Casual.	9,800	
Licenses-Permits	300	
PU Expense (.25 mile)	2,284	
Stumpage	-0-	
Depreciation	49,038	
		$154,671
General		
Office	400	
Bookkeeping	880	
Management	5,642	
Management-PR Txs (10%)	1,304	
Management-Fringe (5%)	326	
Legal-Acctg	400	
Insurance	35	
Travel & Entertainment	375	
		9,362
Other		
Equipment	39,196	
Professional Services	2,400	
Fuel Hauling Contract	55,542	
		97,139
TOTALS		$261,172
Operating Profit (before tax)		52,234
GRAND TOTAL		$313,406

SUMMARY

Ton Cost	$25.39
Ton Sale	30.47(1)

NET PROFIT $ 5.08 = $365,636

Note (1): Seven months per year operating schedule.

The preceding system describes the maximum bioenergy fuel supply cost for the long-term

7: BIOENERGY FUEL HANDLING, PREPARATION AND STORAGE SYSTEM

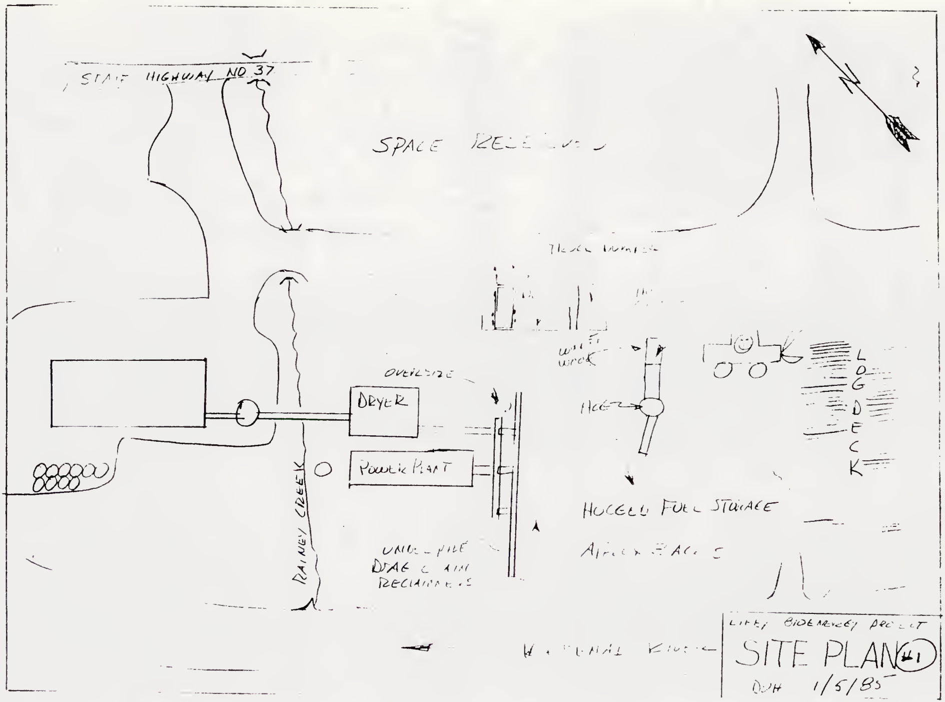
The following figures illustrate the bioenergy fuel handling, preparation and storage system to be used. The system provides for the receiving of several types of forest residue: sawmill waste wood, logging residue, unmerchantable sawlogs and sized wood waste. Trucks can unload by using their own self dumping capability, or use the truck dumps. An on-site grapple can either unload trucks or feed material to the hog. Waste wood will be pushed on to the hog infeed conveyor for processing into boiler fuel. The hog will be a Universal Refiner capable of handling material up to 32 inches in diameter and 8 feet long. a screen on the in feed conveyor will separate 3-inch minus material to reduce the load on the hog. All prepared fuel will be placed on the hogged level storage pile for mixing with fuel already in storage. A description of the fuel handling and storage system is presented in detail in Task 202, Item 4.

8: CONCEPTUAL DRAWINGS

The conceptual drawings showing the fuel handling, preparation, and storage system are shown schematically on Figures 202-4 and 202-5, and shown in plan on Figures 202-14.

9: BIOENERGY FACILITY BID SPECIFICATIONS

The summary bid specifications for the fluidized bed combustor, the cogeneration power plant, and the fuel receiving and storage systems are shown in Task 202, Item 7) Sections A0, B0, and C0, respectively.



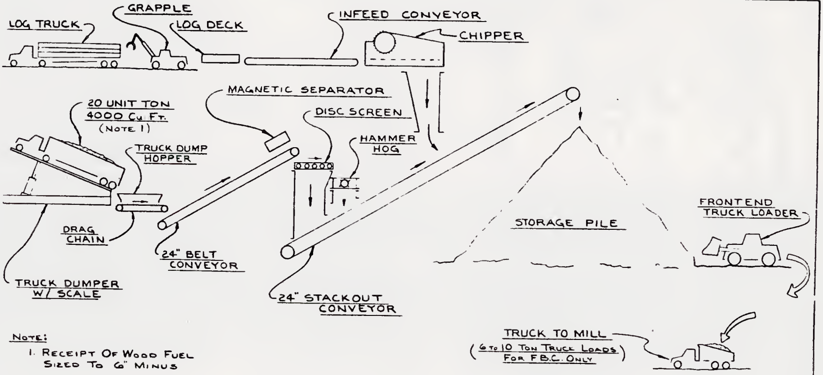
LIBBY BIOENERGY PROJECT
SITE PLAN #1
DJH 1/5/85

8: CONCEPTUAL DRAWINGS

(Drawings being prepared by Omicron Engineers)

The following drawings present the conceptual design for the bioenergy conversion facility fuel handling and preparation system:

Figure No.	Title
202-4	Fuel Handling and Storage Yard
202-5	Fuel Handling and Storage Yard
202-11	Fluidized Bed Combustor Site "C" Layout
202-12	6.8 mw Power Plant Site "C" Layout
202-13	Cogeneration Site Layout
202-14	Fuel Processing Site Plan



NOTE:

1. RECEIPT OF WOOD FUEL SIZED TO 6" MINUS

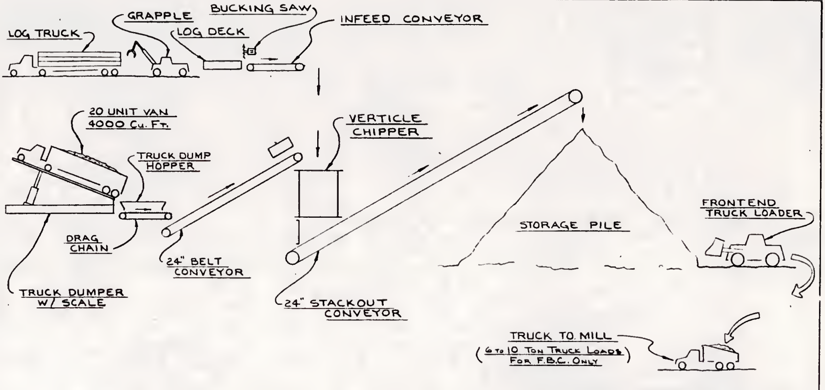
FUEL HANDLING AND STORAGE YARD

OMICRON
ENGINEERS AND CONSULTANTS, INC.
ISSAQUAH, WASHINGTON

Drawn DPT.	Date 12-6-84
Checked	Date

LIBBY MONTANA
BIOENERGY PROJECT

FIGURE NUMBER 202-4



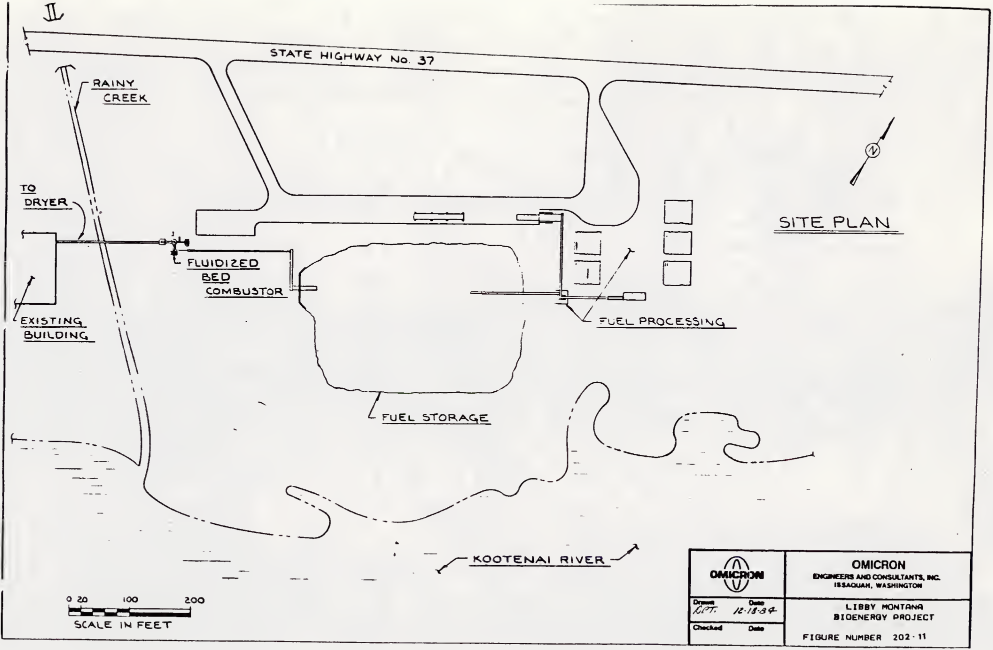
FUEL HANDLING AND STORAGE YARD

OMICRON
ENGINEERS AND CONSULTANTS, INC.
ISSAQUAH, WASHINGTON

Drawn DPT. Date 12-6-84
Checked Date

LIBBY MONTANA
BIOENERGY PROJECT

FIGURE NUMBER 202-5



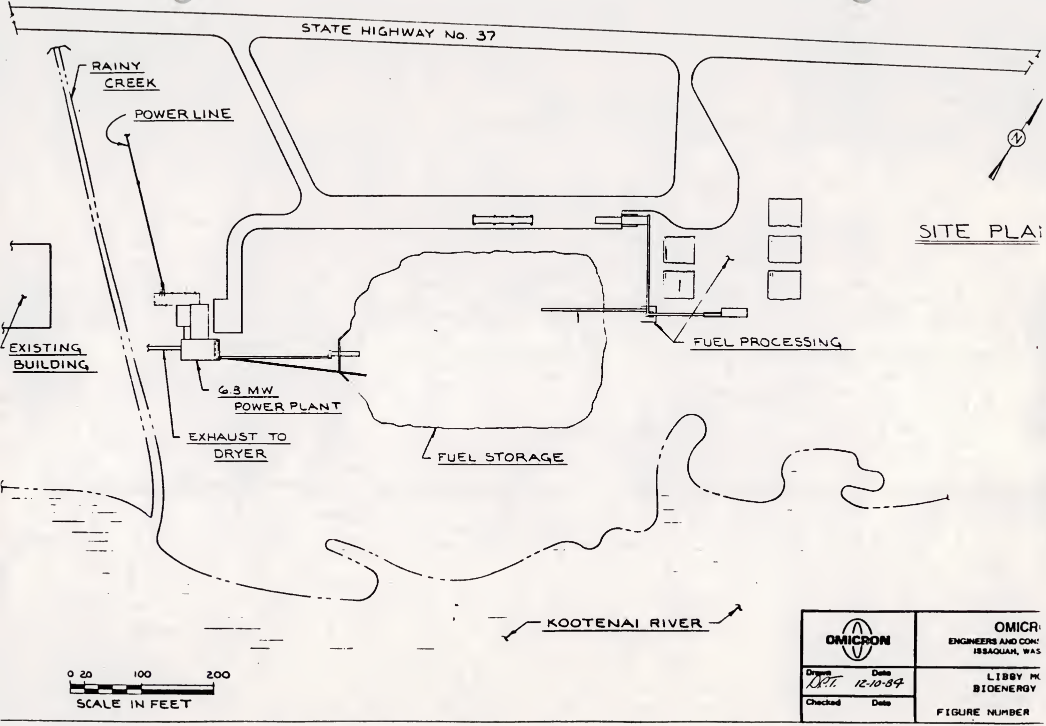
OMICRON
ENGINEERS AND CONSULTANTS, INC.
ISSAQUAH, WASHINGTON

Drawn RPT. Date 12-18-84
Checked Date

LIBBY MONTANA
BIOENERGY PROJECT

FIGURE NUMBER 202-11

II



SITE PLA

OMICRON

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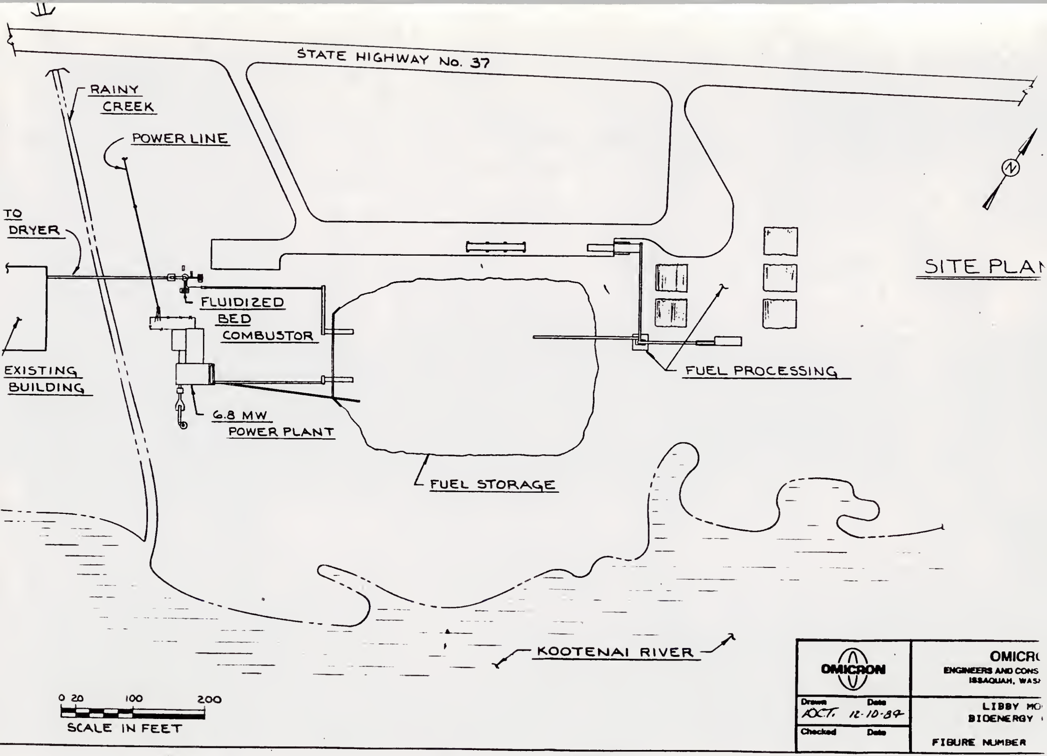
ENGINEERS AND CON
ISSAQUAH, WAS

Drawn D.P.T. Date 12-10-84
Checked Date

LIBBY M
BIOENERGY

FIGURE NUMBER


STATE HIGHWAY No. 37
RAINY CREEK
POWER LINE
TO DRYER
EXISTING BUILDING
FLUIDIZED BED COMBUSTOR
6.8 MW POWER PLANT
FUEL STORAGE
FUEL PROCESSING
SITE PLA
N
KOOTENAI RIVER
0 20 100 200
SCALE IN FEET
OMICRON
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Date
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Date
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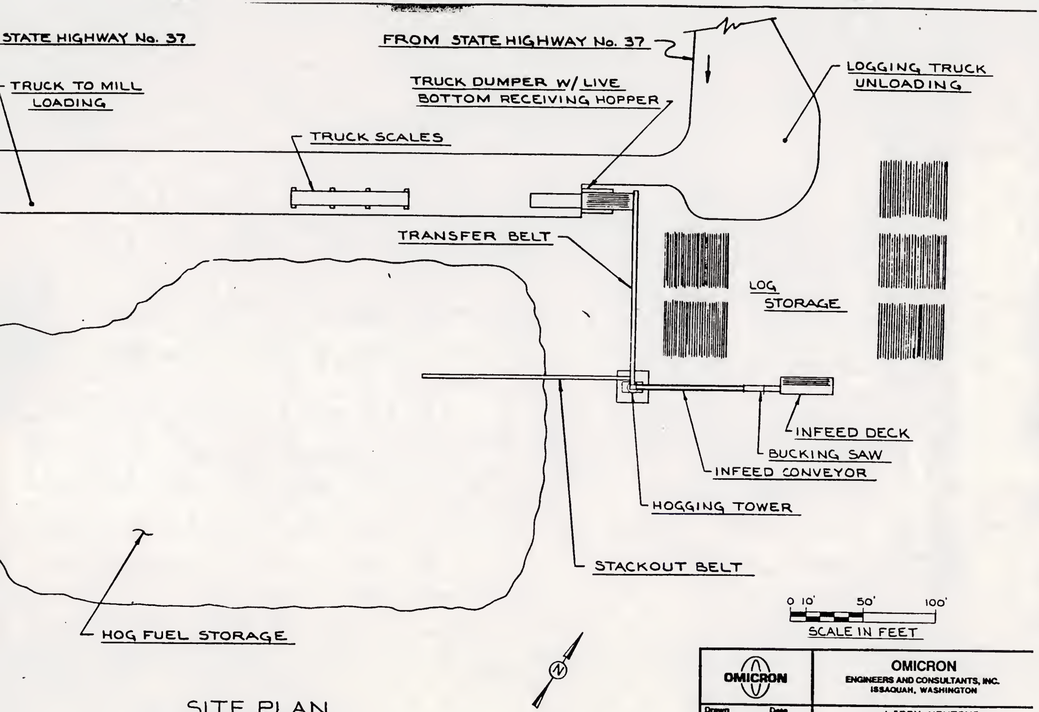
BIOENERGY
FIGURE NUMBER



SITE PLAN
FUEL PROCESSING

OMICRON
ENGINEERS AND CONSULTANTS, INC.
ISSAQUAH, WASHINGTON

Drawn	Date
RCT.	12-10-84
Checked	Date

LIBBY MONTANA
BIOENERGY PROJECT

FIGURE NUMBER 202-14

9: BIOENERGY FACILITY BID SPECIFICATIONS INCLUDING FACILITY PERFORMANCE SPECIFICATIONS

Refer to Task 202 Section 7.

10: BUDGET QUOTATION SUMMARY FROM QUALIFIED SUPPLIERS

Bioenergy Fuel Handling and Preparation System

Refer to Quotations on the following pages.

Refer to Task 202 Section 8 for details

C: List of References

- 1983 Directory of Montana's Forest Products Industry, Montana Department of State Lands, Forestry Division, January 1983.

TASK NO. 202: FUEL COST PERFORMANCE

TASK MANAGEMENT INFORMATION

LIBBY BIOENERGY PROJECT

Activity Schedule

Task Start Date	November 15, 1984
Task Completion Date	December 6, 1984

Personnel Working on Task

Name	Company	Phone No.
Task Leader		
Dave Van Hersett	Resource Development Associates	509/838-8024
Mike Ray	W. R. Grace	406/293-3746
Clayton Rayson	Rayson Brothers Logging	406/293-9306
Jerrie Little	Resource Development Associates	509/838-8024
Sam Van Arsdale	Rayson Brothers Logging	509/926-7818
Tom Peck	CPA	406/293-3729
Ned Dye	Omicron	206/392-0676
Prime Contractor		
Clayton Rayson	Rayson Brothers Logging	406/293-9306
Project Manager		
Dave Van Hersett	Resource Development Associates	509/838-8024

202: Prepare energy conversion facility operations and cost performance specifications for each energy option, forest residues and coal. Prepare conceptual designs and facility specifications. Secure budget quotations from potential suppliers that can provide long-term support in the Libby, Montana area.

Product: For the following major subsystems, prepare conceptual drawings, plan elevation and plat plans. Also prepare a bid specification that includes facility performance requirements.

- Fuel Receiving and Handling Systems (see Task 201, Figures 202-4, 202-5, 202-6, and 202-11.)
- Fuel Conversion System bioenergy and coal burners (see Figures No. 202-1, 202-2, 202-3, 202-7, 202-8, 202-9, and 202-10.)
- Emission Control Systems (see Figure No. 202-1, and 202-2)

A: INTRODUCTION

Phase I results dictated that the energy conversion facilities should include the dryer, steam and electric power production. The dry facility is to be a fluid bed combustor-type hot gas generator. A small waste wood fueled cogeneration unit providing both steam and electric power for the mine is to be evaluated.

B: TASK REPORT TABLE OF CONTENTS

1. Introduction
2. Purpose
3. Description of Bioenergy Conversion Facilities
4. Description of Fuel Receiving and Handling Systems
5. Description of Emission Control System
6. Conceptual Drawings, Process Diagrams, Heat Balance, Plan/Elevation Drawings and Pilot Plans
7. Bid Specifications with Facility Performance Requirements
8. Budget Quotations: Delivered and Erected

TASK 202 FUEL COST PERFORMANCE

1) INTRODUCTION

The first phase of this study identified the energy conversion facilities for burning forest residues or coal in place of oil to supply hot air for W.R. Grace's vermiculite dryer. In addition to the dryer, a cogeneration facility fueled by wood waste and/or coal to supply steam and electricity for the mine is to be evaluated in this second phase. There are several configurations that will be evaluated, these are:

a. The fluidized bed combustor at the top of the hill with a fuel handling system located at the bottom of the hill near the Kootenai River.

b. The fluidized bed combustor at the bottom of the hill adjacent to the fuel handling area.

c. The fluidized bed combustor at the top of the hill with the cogeneration plant at the bottom of the hill adjacent to the fuel receiving and handling facilities.

d. The fluidized bed combustor located at the bottom of the hill next to the cogeneration plant.

e. A conventional solid fuel boiler with the exhaust gasses used to heat the vermiculite dryer at the site at the bottom of the hill (no separate fluidized bed combustor for the dryer).

2) PURPOSE AND TASK DESCRIPTION

This task will describe the energy conversion facilities including the fluidized bed combustor and the conventional cogeneration plant, the fuel receiving and handling systems, and the emission control systems. In addition to the drawings that show the conceptual design of the facilities, performance bid specifications and budget quotes for the major equipment are also included.

3) DESCRIPTION OF THE ENERGY CONVERSION FACILITIES

The description for the facility configurations identified as a. and b. in the introduction are very similar in that they include only the fluidized bed combustor and he associated fuel feed and temporary storage system. Figure 202-3 shows the process heat balance for the combustor at either location and Figure 202-6 shows the process diagram for the fuel handling and storage system at the combustor. Please refer to the Phase I descriptions for Tasks 105 and 108 for the description of the fluidized bed combustor and the secondary fuel storage facility. Figures 202-7 & 8 show the equipment plan and elevation layouts. Figure 202-10 shows the site plan at the top of the hill, and Figure 202-11 shows the site plan at the bottom of the hill adjacent to the primary fuel handling and storage facility. As described in the Phase I report, the fluidized bed combustor and the fuel feed system have been designed to accommodate either coal or sized wood waste.

The configuration "c", fluidized bed combustor to heat the vermiculite dryer and a cogeneration boiler combination, is shown on the site plan Figure 202-13. The two units would share the large fuel handling and storage yard but would have separate reclaim systems (see Item 4 below for the fuel handling description). The fluidized bed combustor has been discussed in Phase I; however, the cogeneration power plant has not and is included here.

The cogeneration power plant consists of the steam generator and the turbine-generator system, with support systems such as fuel handling, ash handling, and water treatment, electrical substation, and controls. The power system is shown schematically on Figure 202-1. The basic operating principles of the system are the following:

A conventional water-cooled pinhole grate boiler is used to burn the hogged wood fuel and produce steam. Fuel enters the boiler through two stokers, each fed by a 20-minute surge bin and a screw feeder. Bottom ash from the burned fuel is collected in hoppers below the furnace grate, periodically passes through a combustion air heater, and enters a mechanical separator followed by a venturi-type wet scrubber to remove particulates.

Steam is generated at 600 psia and 750 degrees F. This temperature and pressure are typical for power boilers in this size range (77,000 lbs/hr.).

Steam leaves the boiler and enters the high pressure end of the turbine. Extraction stream is removed from the turbine at 165 psia to be used for operating the boiler feed water pump driver and for heating feed water in the deaerator. A second extraction, at 50 psia, provides 5600 lbs/hr steam for 3-inches hga (115° F). Cooling water to remove heat from the condenser comes from a mechanical draft cooling tower. The condensed steam is pumped to a direct contact heater/deaerator where it is heated with steam and non-condensibles are removed. Finally, the heated water is boosted by a high pressure pump to the 500 psia boiler pressure before it enters the boiler.

A step-up transformer is utilized to raise the 13,800 volt generator voltage to match the utility line voltage. Protective relaying is installed to meet both the needs of the new generating equipment and the requirements for interconnection to the utility. Relays installed to protect the interconnection include ground fault protection, over current, over and under voltage and under frequency.

A central control room within a pre-engineered building is located near the turbine generator area. It houses the motor control center required for the motor drives in the plant. It also contains all the control panels for the boiler, fuel handling, water, and turbine-generator systems. Data acquisition on all plant operations, control of the boiler and turbine-generator, and monitoring of the alarm status of all systems is possible from this central location.

The description of the energy conversion system that utilizes the conventional boiler to generate the heat for the dryer as well as to generate electricity and process steam is identical to the previous discussion with the following additions:

Off the boiler upstream of the air heater, passed through a mechanical separator to remove the larger ash particles and then directed into the vermiculite dryer. However, to provide enough heat for the dryer (24.8 million BTU/hr), the temperature differential across the dryer must be 470 degrees F (inlet temperature of 610 F and an outlet temperature of 140 F). The process diagram with energy balance is shown on Figure 202-2. A boiler sized for a 6.8 MW electrical output would have approximately 226,550 #/hr. exhaust flow rate, which would be significantly less than the current gas flow through the dryer of approximately 660,000 #/hr. In addition, the inlet and mean temperatures are 850 F and 775 F, respectively, with the current oil burner system. If the surface moisture can be removed from the vermiculite with the lower inlet and mean temperatures and lower gas velocities without product degradation, this may be a satisfactory application. However, it is recommended that tests be run on the existing dryer/burner configuration to evaluate drying with lower air flows and lower temperatures.

The configuration that utilizes the conventional boiler only has to its benefit lower costs for capital equipment but there may be difficulties maintaining satisfactory combustion with very moist fuel and no air preheating at less than full load. The swings in demand for the vermiculite dryer create another degree of complexity for the fuel feed system control.

4) FUEL RECEIVING AND HANDLING SYSTEMS

The fuel receiving and storage facilities adjacent to the fluidized bed combustor at the top of the hill are shown schematically on Figure 202-6 and on the site plan on Figure 202-10. Please refer to the Phase I Report Task 105 for the description of this system.

The main fuel receiving and handling system is shown on Figures 202-4 and 202-5. Figure 202-4 illustrates the fuel handling process utilizing a log chipper to reduce forest residue and surplus logs to the proper size for burning. Logs are unloaded from trucks by a mobile grapple and placed in storage or loaded directly on the log deck that feeds the chipper. A parallel flow path is provided for wood waste that is sized for satisfactory handling in a truck dumper and belt conveying system. Large 20 unit vans will be weighed on the combination truck dumper/scale prior to being emptied into a hopper. The hopper is a disc screen. An electric magnet upstream of the screen removes any potentially damaging tramp iron. The screen allows pieces 3 inches and smaller to pass through onto a belt conveyor for stackout on the storage pile. Oversized pieces are dropped into a hammer hog for size reduction before placement on the storage pile. Fuel is maneuvered in the storage yard by a front-end loader that can load trucks for shipment to the top of the hill or pile fuel on the reclaim conveyors for the energy conversion facilities adjacent to the fuel yard.

An alternate to using a separate chipper and hammer hog as described above is to install a single Universal Refiner. The refiner also provides its own screening, thereby eliminating the need for the disc screen as well. A bucking saw is required to cut the logs into segments that can be loaded into the refiner.

5. EMISSIONS CONTROL SYSTEMS

The configuration that has the fluidized bed combustor at the top of the hill uses a multiple cyclone particulate collector and the existing vermiculite dryer fabric filter dust collector (bag house) to reduce the particulate emissions for the combustor carryover and the dryer dust carryover. Gaseous emissions such as oxides of nitrogen, carbon dioxide and sulfur dioxide will be untreated. The nitrogen oxides and the carbon dioxide levels will be equal or less than the existing oil fired burner emissions for both the wood and coal fuel cases. The coal, however, has a small amount of sulfur (0.3%) that will produce about 85.8 tons per year of sulfur dioxide.

The emissions control for the stand alone conventional boiler cogeneration plant will have a multiple cyclone particulate collector and venturi-type flue gas scrubber. The particulate emissions will be 211 and 232 tons per year, respectively for 100% burning of wood and 100% burning of coal. The gaseous emissions of carbon dioxide, oxides of nitrogen, and sulfur dioxide will be untreated. The listing below shows the anticipated levels of these emissions for wood and coal:

Emission (tons/yr)	Wood	Coal
CO	112	169
NOx	112	225
SO2	---	422

For the configuration that utilizes the conventional boiler to provide the hot gasses for the vermiculite dryer, a particulate removal method other than a fabric filter (bag house) will be necessary since the exhaust gas temperature out of the dryer will be too low to prevent caking due to moisture. An electro-thermostatic precipitator or venturi scrubber would be suitable for this application. The scrubber having the lower initial capital cost will have higher operating costs. The estimated emissions for this configuration are listed below:

Emissions (tons/yr)	Wood	Coal
CO	131	197
NOx	131	263
SO2	---	492
Particulate	246	271

6. CONCEPTUAL DRAWINGS

The following is a listing of the figures that comprise the conceptual drawings for Task 202:

Figure Number	Description
202-1	System diagram & heat balance cogeneration plant
202-2	System diagram & heat balance cogeneration plant with exhaust to dryer
202-3	System diagram & heat balance fluid bed combustor
202-4	System diagram fuel handling with chipper and hog
202-5	System diagram fuel handling with vertical chipper
202-6	System diagram fuel handling & storage for fluid bed combustor
202-7	Plan view-fluid bed combustor
202-8	Plan view-cogen. power plant
202-9	Elevation view-cogeneration power plant
202-10	Site plan-fluid bed combustor
202-11	Site plan-fluid bed combustor & fuel handling at river
202-12	Site plan-cogeneration power plant handling at river
202-13	Site plan-fluid bed & cogeneration plant at river
202-14	Site plan-fuel receiving with vertical chipper

7. SUMMARY BID SPECIFICATIONS - FACILITY PERFORMANCE REQUIREMENTS

Following are the summary specifications for the three major systems or component groups. They are the fluidized bed energy conversion system, the cogeneration power plant, and the fuel receiving and storage systems. These summary specifications are not intended to be rigorous and are not sufficient for satisfactory bid requests and evaluations.

A) Fluidized Bed Energy Conversion System

1. A system utilizing wood waste and/or coal shall produce 24.8 MMBTU/hr. in the form of blended hot exhaust gasses at 850 degrees F. and 108,000 to 125,000 pounds per hour for use in the vermiculite dryer. The system is to be located near Libby, Montana at an approximate 3500 foot elevation.

2. The scope of supply of the fluidized bed energy conversion system shall include all equipment, materials and installation from the fuel dump hopper through the connection at the vermiculite dryer including all auxiliaries.

3. The exhaust shall be cleaned prior to entering the dryer so that there is less than 01.8 gr/SCF of particles 10 microns or larger.

4. The fuel feed system must handle wood waste sized to 3" minus and coal three-eighths minus without significant modification or operator interaction.

5. The dual feed and storage system shall be able to supply enough fuel for 100% output for 16 hours.

6. The fuel burn rate shall be less than 6200 #/hr for wood at 4000 BTU/# and 3260 #/hr for coal at 8000 BTU/# at the rated output.

7. An ash removal system shall be provided for manual or automatic ash removal from the combustor and mechanical separator.

8. All controls for fuel feed and combustion air flow are to be included.

9. All structural steel, component support steel and access platforms are to be included.

10. The installation services shall include site preparation, 30-day start up and operator training.

B) Cogeneration Power Plant

1. The cogeneration power plant shall produce, on a continuous basis, 6.0 MW of net electrical power as well as 5600 #/hr of 50 psia saturated steam for process use.

2. The scope of supply shall be from the fuel surge bins at the boiler through the exhaust stack and the electrical tie-in with the utility, including boiler, turbine generator, and all auxiliary equipment.

3. The fuel burn rate shall be 32,200 #/hr for wood with a nominal heating value of 4000 BTU/# at 40% moisture.

4. The flue gas cleanup system and boiler combustion controls shall limit the particulate, NOx and CO emissions to 246 tons/yr., 131 tons/yr., and 131 tons/yr., respectively.

5. All controls for fuel feed and combustion air flow are to be included.

6. All structural steel, component support steel and access platforms are to be included.

7. An ash removal system shall be provided for ash removal from the boiler hoppers and dust collection equipment.

8. A water treatment system shall be provided to pretreat boiler makeup water and to provide chemical treatment to the feedwater compatible with the boiler operating conditions.

9. The boiler, turbine generator and all other equipment that requires protection from the elements shall be inside a building(s).

10. The cooling water for the steam condensor shall be provided by cooling tower.

11. All pumps associated with the power cycle shall have 100% installed spares.

12. The power plant shall have zero waste water discharge.

13. The installation services shall include site preparation, 30-day startup and operator training.

C) Fuel Receiving, Handling, and Storage

The scope of supply for the fuel receiving, handling and storage system shall include all support steel, power and control wiring, drivers (motor or engines), and all materials, components, and installation services required for a fully operational system. Foundations will be provided by others.

1. The fuel receiving system scope of supply shall include a truck scale, truck dumper with live bottom drag chain conveyor, electro magnet, disc screen, hammer hog, and the conveyor belts connecting the truck dumper with the screen receiving system shall be sized to handle four 18-unit truck loads of wood waste consisting of 6-inch minus material in one hour.

2. The fuel reclaiming system shall include an under pile drag chain reclaimer a minimum of 48 inches in width, a conveyor belt to the boiler building, a flight conveyor to distribute the fuel to the feeder surge bins, and a return conveyor back to the storage yard. The reclaiming system shall be sized to continuously supply 3-inch minus wood waste material to the boiler at a rate of 36,000 #/hr.

3. As an option, the fuel receiving system shall have a separate subsystem to handle whole logs. A log deck, feed conveyor, and a whole log chipper shall be supplied and installed. The subsystem shall be sized to handle 18-inch diameter logs and produce 60 tons per hour of 3-inch minus material.

8. BUDGET QUOTATIONS: Delivered and Erected

The budget costs for the fluidized bed combustor and the associated fuel handling system were presented in Phase I Task 105 Tables 1, 2, and 3. The budget costs for the cogeneration power plant to produce process steam and 6.8 MW of electricity are presented below:

A) Boiler Package

- Steam Generator with Controls
- Water-Cooled Pinhole Grate
- Mechanical Particulate Collector
- Venturi-Type Wet Scrubber
- Stack
- Forced Draft Fan, Induced Draft Fan, Overfire Air Fan
- Deaerator
- Boiler Feedwater Pumps

Price Installed: $2,630,000

B) Turbine/Generator Package

- Steam Turbine with Lube Oil System and Controls
- Condensor

Price Installed: $750,000 (used reconditioned)

C) Miscellaneous Pumps

- Condensation Pumps (2)
- Circulating Water Pumps (2)
- Circulating Water Booster Pumps (2)
- Building Pumps (2)
- Boiler Blowdown Pump
- Fire Water Pump

Price Installed $80,000

D) Miscellaneous Mechanical Equipment

- Air Compressor System
- Building Ventilation Units
- Control Building HVAC
- Building Units Heaters
- Piping and Valves

Price Installed: $335,000

E) Fuel Handling Equipment

- Truck Dumper and Scale
- Truck Dumper Hopper with Live Bottom
- Belt Conveyor to Hog Tower
- Disc Screen
- Hammer Hog
- Stackout Conveyor
- Reclaim Pit with Live Bottom
- Belt Conveyor to Boiler House
- Flight Conveyor for Fuel Distribution
- Returns Conveyor to Fuel Pile

Price Installed: $950,000

F) Electrical Equipment

- Earth Work
- Foundations for Boiler, Turbine, and Control Buildings
- Foundations for Fuel Handling, Cooling Tower and Misc. Equipment
- Structural Steel for Buildings and Walkways
- Siding, Roofings, Insulation
- Drains, Sewer, Grading and Miscellaneous

Price Installed: $650,000

H) Project Engineering and Indirect Costs

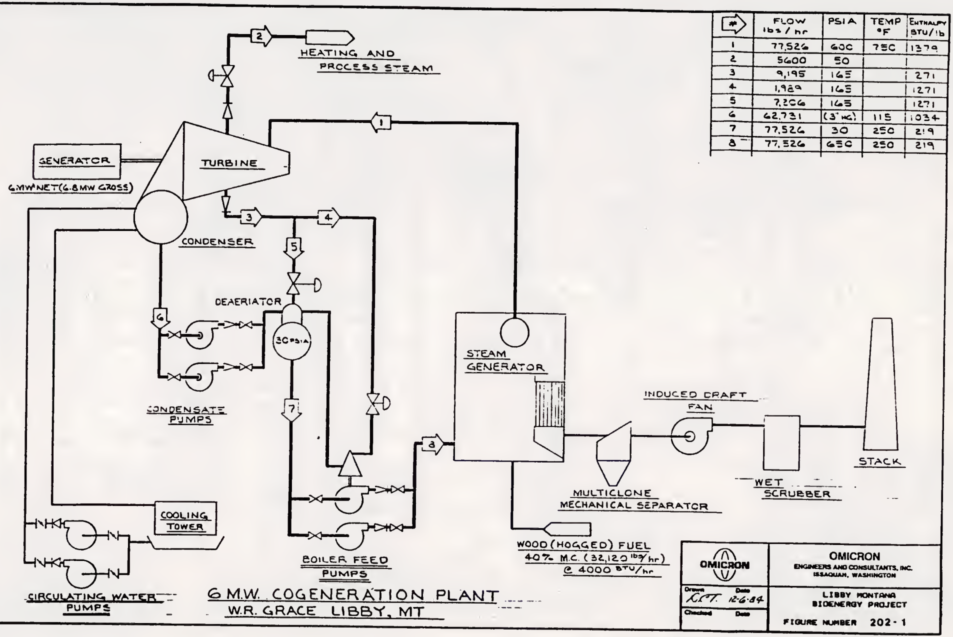
- Engineering
- Site Supervision
- Miscellaneous Construction Fees and Costs
- Contingency
- Profit

Price: $1,675,000

TOTAL PROJECT BUDGET COST: $7,490,000

List of References

. Energy Products of Idaho, Coeur d'Alene, Idaho



#	FLOW lbs/hr	PSIA	TEMP °F	ENTHALPY BTU/lb
1	77,526	600	750	1379
2	5600	50		
3	9,195	165		271
4	1,929	165		1271
5	7,206	165		1271
6	62,731	(3" HG)	115	1034
7	77,526	30	250	219
8	77,526	650	250	219

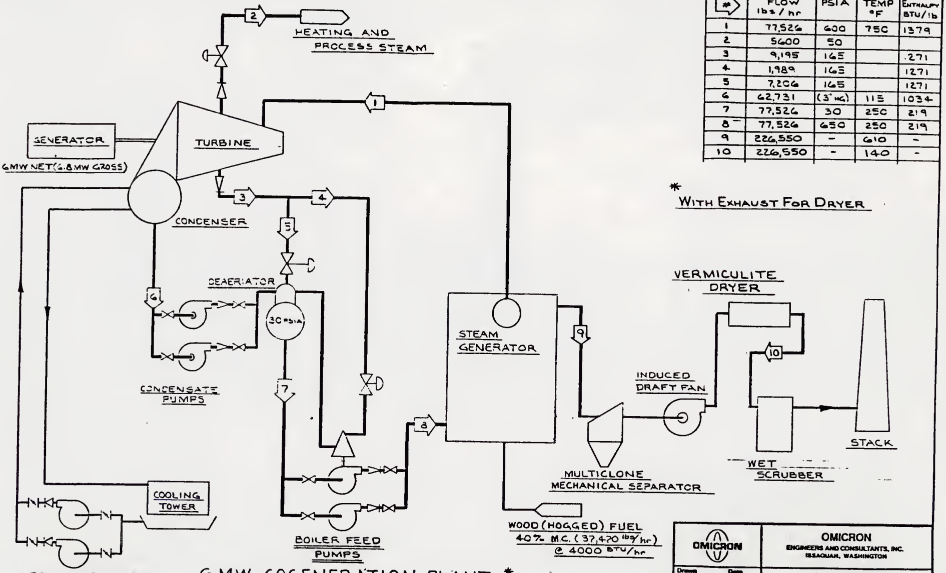
6 M.W. COGENERATION PLANT
W.R. GRACE LIBBY, MT

OMICRON
ENGINEERS AND CONSULTANTS, INC.
ISSAQUAH, WASHINGTON

Drawn KCT. Date 12-6-84
Checked Date

LIBBY MONTANA
BIOENERGY PROJECT

FIGURE NUMBER 202-1



#	FLOW lbs / hr	PSIA	TEMP °F	ENTHALPY BTU/lb
1	77,526	600	750	1379
2	5600	50		
3	9,195	165		1271
4	1,989	165		1271
5	7,206	165		1271
6	62,731	(3" HG)	115	1034
7	77,526	30	250	219
8	77,526	650	250	219
9	226,550	-	610	-
10	226,550	-	140	-

* WITH EXHAUST FOR DRYER

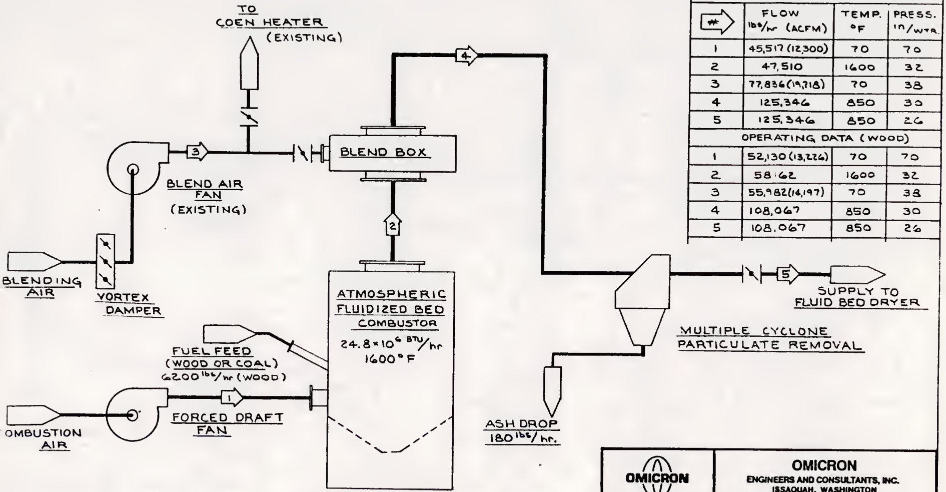
6 M.W. COGENERATION PLANT *
W.R. GRACE LIBBY, MT

OMICRON
ENGINEERS AND CONSULTANTS, INC.
ISSAQUAH, WASHINGTON

Drawn KKT. Date 12-6-84
Checked Date

LIBBY MONTANA
BIOENERGY PROJECT

FIGURE NUMBER 202-2



OPERATING DATA (COAL)			
#	FLOW lbs/hr (ACFM)	TEMP. °F	PRESS. in/WTR.
1	45,517 (12,300)	70	70
2	47,510	1600	32
3	77,836 (19,718)	70	38
4	125,346	850	30
5	125,346	850	26
OPERATING DATA (WOOD)			
1	52,130 (13,226)	70	70
2	58,162	1600	32
3	55,982 (14,197)	70	38
4	108,067	850	30
5	108,067	850	26

(ALTITUDE 3500' ABOVE SEA LEVEL)

SOLID FUEL
COMBUSTION DIAGRAM

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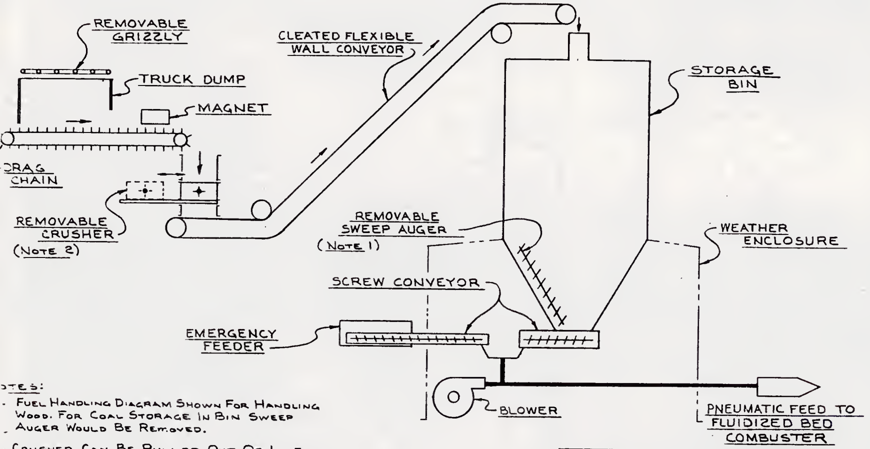
ENGINEERS AND CONSULTANTS, INC.
ISSAQUAH, WASHINGTON

Drawn	Date
D.C.T.	12-12-84
Checked	Date

LIBBY MONTANA
BIOENERGY PROJECT

FIGURE NUMBER 202-3


REMOVABLE GRIZZLY
TRUCK DUMP
MAGNET
CLEATED FLEXIBLE WALL CONVEYOR
STORAGE BIN
RAG CHAIN
REMOVABLE CRUSHER (NOTE 2)
REMOVABLE SWEEP AUGER (NOTE 1)
WEATHER ENCLOSURE
SCREW CONVEYOR
EMERGENCY FEEDER
BLOWER
PNEUMATIC FEED TO FLUIDIZED BED COMBUSTER

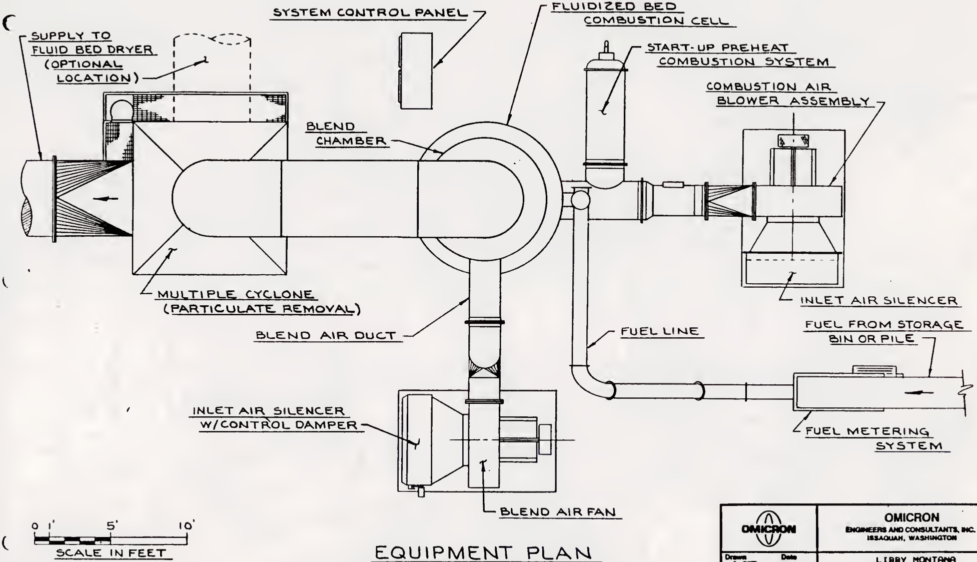
OTES:

- Fuel Handling Diagram Shown For Handling Wood. For Coal Storage In Bin Sweep Auger Would Be Removed.

Crusher Can Be Pulled Out Of Line For Maintenance Or During Non-Freezing Months.

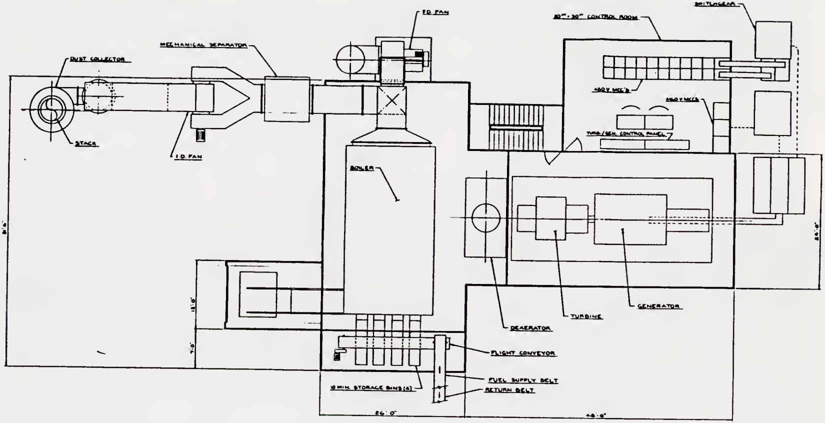
FUEL HANDLING DIAGRAM

OMICRON	**OMICRON** ENGINEERS AND CONSULTANTS, INC. ISSAQUAH, WASHINGTON
Drawn A.P.T. Date 12-6-84	LIBBY MONTANA BIOENERGY PROJECT
Checked Date	FIGURE NUMBER 202-6


SYSTEM CONTROL PANEL
FLUIDIZED BED COMBUSTION CELL
SUPPLY TO FLUID BED DRYER (OPTIONAL LOCATION)
START-UP PREHEAT COMBUSTION SYSTEM
COMBUSTION AIR BLOWER ASSEMBLY
BLEND CHAMBER
MULTIPLE CYCLONE (PARTICULATE REMOVAL)
INLET AIR SILENCER
BLEND AIR DUCT
FUEL LINE
FUEL FROM STORAGE BIN OR PILE
INLET AIR SILENCER W/CONTROL DAMPER
FUEL METERING SYSTEM
BLEND AIR FAN
0 1' 5' 10'
SCALE IN FEET

EQUIPMENT PLAN
FLUIDIZED BED COMBUSTOR

OMICRON	**OMICRON** ENGINEERS AND CONSULTANTS, INC. ISSAQUAH, WASHINGTON
Drawn RFT. Date 12-12-84	LIBBY MONTANA BIOENERGY PROJECT
Checked Date	FIGURE NUMBER 202-7



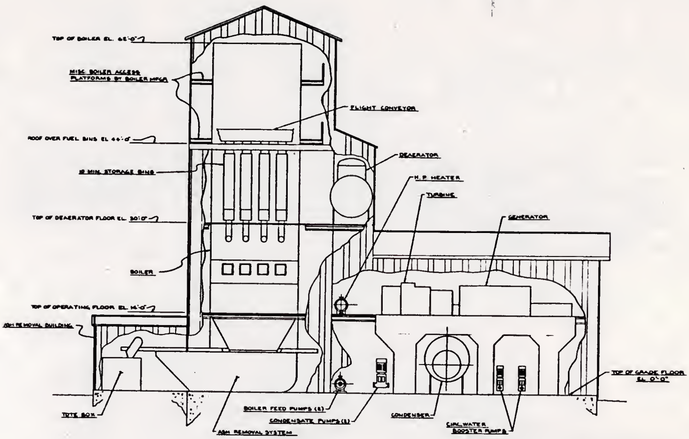
PLAN VIEW
6.8 M.W. POWER PLANT

OMICRON
ENGINEERS AND CONSULTANTS, INC.
ISSAQUAH, WASHINGTON

Drawn LOT Date 12-12-84
Checked Date

LIBBY MONTANA
BIOENERGY PROJECT

FIGURE NUMBER 202.8



ELEVATION VIEW
LOOKING WEST
6.8 M.W. POWER PLANT

OMICRON

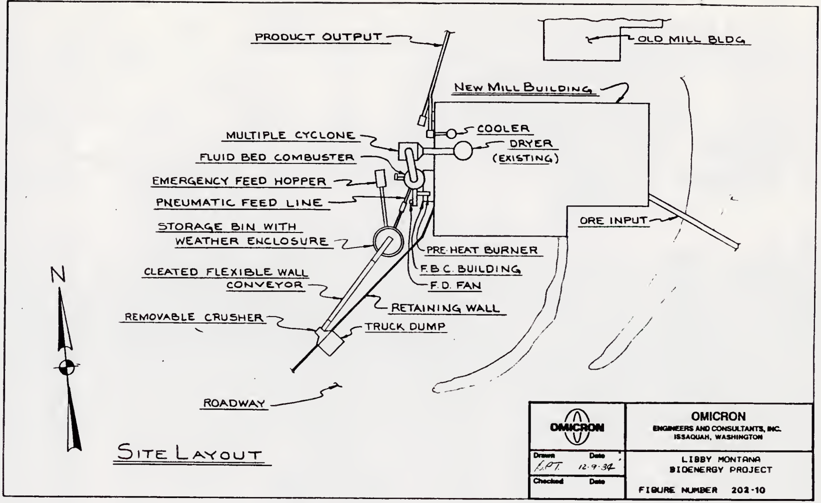
OMICRON
ENGINEERS AND CONSULTANTS, INC.
ISSAQUAH, WASHINGTON

Drawn Date

Checked Date

LIBBY MONTANA
BIOENERGY PROJECT

FIGURE NUMBER 202-9



SITE LAYOUT

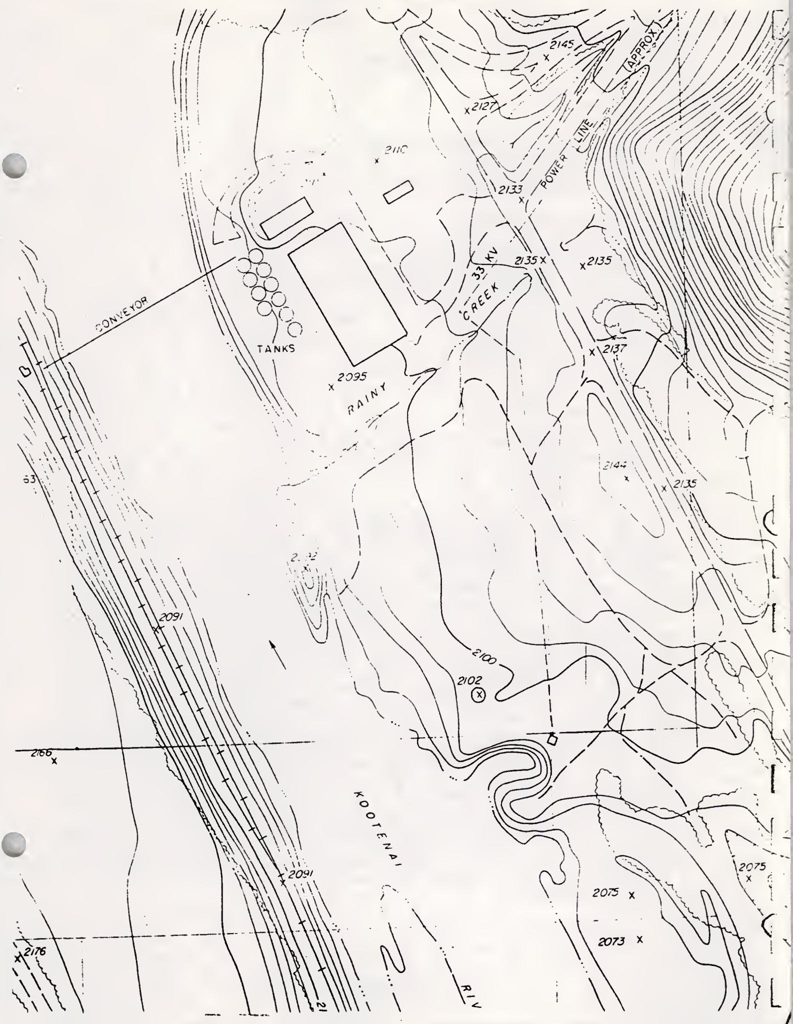
OMICRON

OMICRON
ENGINEERS AND CONSULTANTS, INC.
ISSAQUAH, WASHINGTON

Drawn	Date
R.P.T.	12·9·84
Checked	Date

LIBBY MONTANA
BIOENERGY PROJECT

FIGURE NUMBER 202-10


2145
(APPROX)
x2127
2110
POWER LINE
2133
33 KV
2135 X
X2135
CREEK
CONVEYOR
TANKS
X 2137
x 2095
RAINY
2144
x 2135
63
2091
2100
2102
2166
KOOTENAI
2091
2075
2075
2073
2176
RIV
21

Title Page

1. Grantee:

   Rayson Brothers Logging Company
   Route 1, Box 886
   Libby, Montana 59923
   406/293-9306

2. Project Consultant:

   David G. Van Hersett, P.E.
   Resource Development Associates
   West 601 Main Avenue, Suite 301
   Spokane, WA 99201
   509/838-8024

3. Location of Project:

   Libby, Montana

4. Funding:

Total Project Cost:	$2,421,510
Amount of Grant:	116,000

5. Project Scope:

The Grantee shall investigate, design and document the feasibility of using forest residue in the vicinity of Libby, Montana to replace oil and coal as a long-term, cost-effective, dependable energy supply for the vermiculite mine. The Grantee shall research and document basic information including, but not limited to a site specific data base of wood resources, recovery and combustion technology data, environmental and economic constraints, institutional barriers and interfaces, and the development of specific guidelines for facility sizing for the proposed bioenergy supply and conversion facilities. The Grantee shall develop the conceptual and preliminary engineering designs and cost estimates for all required bioenergy facilities and compare the economics and risks to the present oil facility and to a coal option. The Grantee shall document proven fuel supply systems, fuel supply contracts, permits and licenses, financial, environmental, siting and management requirements. The Grantee shall seek to demonstrate that the proposed energy fuel is a reliable, cost-effective substitute for coal and oil at the W.R. Grace mine. More specifically the Grantee shall perform the following tasks that have been organized into a sequence of project milestones. The milestones have been organized to provide the most important information as early as possible so that the study can be terminated if the project does not appear feasible.

Tasks 203: Fuel Supply Cost

1.0 Introduction

The fuel supply system developed in Phase I to meet the needs of W.R. Grace & Co. yields the lowest cost firm bioenergy supply system and utilizes the best options of the existing forest products industry as follows: 20-year contract with Rayson Brothers Logging Company to supply bioenergy fuel to W. R. Grace & Co. Rayson Brothers will use its expertise in the local forest products industry to secure fuel from several area sawmills. This low cost fuel will be backed up by nearby logging residue recovery operations. The third level of long-term back-up will be blending coal shipped in from a Canadian coal mine 110 miles away. Short term back-up will be provided by using existing oil and propane systems now operated by W. R. Grace & Co.

2. Task Description and Purpose

Prepare fuel supply system operational and cost performance specifications for each energy option, forest residue and coal. Define in detail the fuel resource base reserves. Explore methods to secure rights to secure bioenergy resources with the forest residue managers. Locate documentation sources that identify the existence of non-used renewable forest residues. Supported with documented experience of currently operating successful forest residue recovery operations combined with the decades of Rayson Brothers logging experience in the Libby area, prepare bioenergy fuel supply system operational and cost performance specifications. Prepare the expected delivered fuel specification. Prepare similar information for the coal option.

Product: Fuel supply system operational and cost characteristics for bioenergy and coal fuels.

3. Define Resource Base for Each Energy Option: Bioenergy and Coal

3.1 Bioenergy Resource Base (Waste Wood)

The primary industry in Northwestern Montana is the forest products industry. A study conducted by Charles E. Keegan, III and Timothy P. Jackson titled "Mill Residue Availability in the Inland Empire", Bureau of Business and Economic Research, University of Montana, Missoula, Montana concluded that 3,263,000 tons per year of mill residue is produced by the sawmills within a 100-mile haul of Libby. Existing pulp mills and board plants use 1,936,000 tons per year; 1,000,000 tons per year is existing log fuel uses, miscellaneous 25,000 tons per year and 288,000 tons per year unutilized. This report confirms the results of the sawmill fuel survey conducted in Task 201. Our own survey of 26 sawmills within a 100-mile haul of Libby identified 313,000 tons per year of millwaste. Fourteen sawmills producing 168,000 tons per year were identified as potential suppliers.

3.2 Coal Resource Base

Two major metallurgical coal mines are in operation in Canada 110 miles north of Libby, Montana. They market coal worldwide. The annual coal production from their mines ranges from two to six million tons per year. A lower quality thermal coal is produced in the process of mining for the higher quality metallurgical coal. One to two million tons per year are sold to foreign and domestic markets. The proven coal reserves are in excess of 500 million tons for all three coal mines. Approximately 100 to 200 million tons of coal are expected to be mined in the next 20 years.

A third coal, refuse coal, a waste byproduct of the coal washing plant, is available for purchase. Several large coal refuse piles are available, and these refuse coal piles are expected to grow each year. The 30 percent ash and high proportion of fines make this coal undesirable for export. Approximately 500,000 tons are currently available. The mine produces approximately 500,000 tons of refuse coal annually. The conclusion is that there is a long-term fuel supply reserve to provide a secure coal fuel supply for the project.

4. Secure Commitments From Forest Residue Managers And Sawmills Interested In Being Potential Fuel Suppliers.

4.1 Forest Residue Suppliers

Both the U. S. Forest Service and the Montana Department of Forestry have actively participated in this feasibility study. In Milestone 1 and 2, the U. S. Forest Service staff assisted in the identification of the procedures we would use to utilize forest residues. Because of the public lands policies, no long-term commitment can be offered by either the U. S. Forest Service or the Montana Department of Forestry. However, as no local market exists for forest residues, we can bid at public auction for the rights to these waste materials. We would be the only bidder, so would be able to secure fuel supplies. The procedures and sample forms are in the appendix of this report. Additionally, our forester working with the U. S. Forest Service staff has prepared an outline of an agreement that could be used to secure the rights to forest residue. This outline is in the appendix of this report.

4.2 Sawmill Residue Sources

Twenty-seven sawmills were surveyed to determine the quantity of sawmill waste wood available and determine the interest in being a potential supplier of fuel. Fourteen sawmills indicated an interest, representing 168,225 tons per year of sawmill waste wood. A follow-up survey form was sent to the mills expressing interest. Seven of the 14 sawmills responded, representing 168,225 tons per year of fuel.

5. Availability of Forest Residue as a Fuel Supply Reserve.

Large quantities of forest residue exist in the area surrounding Libby, Montana. As discussed in Phase 1, the two most readily available components are stand conversion residue and logging residue. The focus of the analysis for a fuel supply was originally directed at stand coversion residue. It was believed that if sufficient volumes of residue from stagnant stands of lodgepole pine were available under the right conditions (road and on slopes under twenty percent), Rayson Brothers would offer the W.R. Grace plant a long-term secure source of wood fiber for fuel at a reasonable cost. The analysis revealed that volumes available under these "right conditions" would not be sufficient to supply the entire needs of the W. R. Grace plant.

The decision was made, therefore, to use wood fiber residue from the manufacture of lumber (mill residue) as the primary source and to propose forest residue material from stagnant lodgepole pine sites or logging residue as a backup fuel source. This backup source may be required only in years in which lumber production and related mill residue output was significantly below average.

Frequency: A backup fuel supply may be required only in recession years for the wood products industry. These are years in which lumber production and related mill residue output is reduced significantly below its normal level. This has occurred in four of the previous ten years, but only five of the last 25 years. It is difficult to predict the occurrence of the downturns in the industry but based on historical data, from one year in three to one year in five can be expected to be a year of low lumber production.

Stagnant Lodgepole Pine Stands: As indicated in Phase 1 (Table 101-A-2), given a fifteen-year liquidation schedule, slightly more than 6,200 green tons per year would be available annually from the conversion of stagnant lodgepole pine stands on level terrain. If the material from these stands was needed only intermittently -- every three to five years -- several times the 6,200 green tons would certainly be available in the years in which the forest residue material was required. There is no current or projected demand for the material, and land managers in the region have funds to pay to convert only a very small portion of acreage in need of conversion. Other uses and land management treatment will therefore eliminate only a very small portion of the total volume available.

Logging Residue Availability: Logging residue material currently left on logging sites would offer an alternative fuel supply which should be readily available in large volumes even in years when mill residue is in low supply.

Logging residue volumes are reduced in nearly direct proportion to harvest levels.[1] Based on 1982 harvest levels in Kootenai National Forest, supplies of logging residue in the Libby area would have been reduced approximately twenty-five percent over the level for a year of average timber harvest. Logging residue volumes for a year such as 1982 -- the worst year for the industry since the Great Depression -- would still exceed 150,000 green tons if only cull logs were recovered. Whole tree logging opportunities would increase this volume by an additional 200,000 to 250,000 green tons. Costs and estimated available volumes are indicated in Table 203-A-1.

---

[1] It is true that utilization standards change during recession years. For example, more pulp wood is often harvested. The inventory on which the volume estimates were made was done during 1982, a recession year, and, therefore, should be representative of utilization during a recession year.

Table 203-A-1

Volumes and Cost of Logging Residue Available During a Recession Year Through Alternative Recovery Systems Libby, Montana Supply Zone 1986 - 1995

Residue Recovery System	Volume (000s Green Tons)	Estimated Cost[a] (1984 Dollars)
Log-length system[b]		
Tractor ground	135	$20/green ton
Cable ground	45	$50/green ton
Whole tree systems[c]		
In-woods processing	195[d]	$14-26/green ton
Mill site processing	225[e]	$10-24/green ton[f]
	60[g]	$26/green ton

Source: University of Montana, Bureau of Business and Economic Research, Libby, Montana Logging Residue Inventory (Missoula, Montana 1984).

[a] Costs do not include profit and risk.
[b] A log-length system involves recovering cull trees, logs, and cull portions of sawtimber trees in conjunction with the sawtimber logging operation.
[c] Whole tree systems involve recovering unmerchantable tops and crowns of sawtimber trees as well as crowns, tops, and boles of submerchantable trees not part of sawtimber growing stock.
[d] Crowns and unmerchantable tops of sawtimber trees and whole submerchantable trees.
[e] Crowns and tops of sawtimber trees.
[f] Does not include additional haul cost if the wood fiber is not processed at the same mill at which the sawtimber is processed.
[g] Whole submerchantable trees.

During the previous recession years of 1974, 1975, 1980, 1981, and 1982, a portion of the logging work force shifted to the harvest of dead and cull green timber (forest residue) to supply the pulp and paper industry. The pulp and paper industry normally is supplied by coarse or chippable mill residue which is reduced below demand in years of lower than average lumber and plywood production.[1] The total timber harvest including pulpwood during these recession years has generally been well below the average. Indicated below are total timber harvest levels on the Kootenai National Forest for the years 1974 through 1983.

---

[1] The W.R. Grace plant would not be competing for the chippable component of mill residue. The mill residue used for fuel would be bark and fine residue of which there is a much larger excess supply.

Year	Million Board Feet Scribner (MMBF)	Year	Million Board Feet Scribner (MMBF)
1974	144	1979	178
1975	154	1980	138
1976	188	1981	159
1977	224	1982	127
1978	199	1983	225

Source: U.S. Forest Service, Region 1.

During these recession years, logging has been down considerably, indicating an underutilized logging work force. Presented below is employment in Lincoln County, Montana's wood products industry from 1974 through 1982.

Year	Number of Workers	Year	Number of Workers
1974	1,255	1979	1,552
1975	1,213	1980	1,192
1976	1,345	1981	1,222
1977	1,501	1982	906
1978	1,501		

Source: U.S. Department of Commerce.

Average employment during the recession years of 1974, 1975, 1980, 1981, and 1982 was 1,158 workers versus 1,475 during the nonrecession years, a difference of 317 workers on the average. Approximately half of these would be loggers and half mill workers. This would leave, on the average, 160 loggers without work for the average recession year in the area, a work force sufficient to harvest well in excess of 100,000 green tons of wood fiber per year. Loggers in the past have shifted readily to the harvest of forest residue to supply the pulp and paper industry, so the same shift could be expected to supply a demand for industrial fuel wood.

The W.R. Grace plant would, of course, have to pay prices in line with the recovery costs detailed earlier, but the wood residue material would certainly be available in adequate volumes at these costs, and a work force would be readily available to recover it.

In addition, the need of the W.R. Grace plant to shift to forest residue as an alternative supply should be very limited, given the relatively small volumes of wood required.

Reductions in the total supply of mill residue in the past have been larger in volume but relatively small on a percentage basis, representing a decline in total mill residue supply of less than 35 percent. (Keegan and Jackson 1984). If the mill residue supply contracts involve several mills, it is highly unlikely that the output of lumber and related residue supplies would be large enough to force the plant to rely on forest residue for more than a small percentage of its needs even during recession years. Based on 1982 production levels, the worst year for the wood products industry since the Great Depression, available mill residue supplies in the Lincoln County area would have been sufficient to supply the proposed W.R. Grace facility, given that long-term contracts for mill residue were in effect. In the future, a purchaser attempting to enter the mill residue market only in years of below average lumber production would find uncommitted mill residue in very short supply.

6. Document Rayson Brothers Proposed Forest Residue Recovery System

The proposed Forest Residue Recovery System to be used by the Rayson Brothers is described in Task 201. The following are manufacturers' brochures describing the major equipment pieces:

- Timberjack: Clambunk Skidder
- Feller Buncher
- Loader
- Truck/trailer

These pieces of equipment can be seen in operation at the following Pacific Northwest locations:

1. Gene Crismane Chipping Plant
   LaGrande, Oregon.
2. Forest Enterprises, Inc.
   Usk, Washington
   Robert Hermanson, President
3. Louisiana - Pacific Corporstion
   Chilco Wafer Board Plant
   Chilco, Idaho
4. Herman Brothers
   Port Angeles, Washington
5. Universal Refiner Corporation
   Montesano, Washington

These pieces of equipment are supported by the following firms or equipment dealers:

- Sims Equipment Company, Bonners Ferry, Idaho

7. Secure Current Coal Supply Data

The following information includes: coal specification, cost structure, term and contract conditions.

7.1 Coal Specifications:

The following are the coal specifications for two types of coal available from Canadian coal mines 110 miles north of Libby. One is a thermal coal and the other is a high ash refuse coal, a by product of the coal mining, coal washing plant.

ELKVIEW REFUSE COAL SPECIFICATIONS
JANUARY, 1985

	COARSE	FINE
ANNUAL PRODUCTION MILLION TONS (DRY BASIS)	1.7	0.6
TOTAL STORED MILLION TONS (DRY BASIS)	14.2	7.4
TOTAL MOISTURE	6.0	15.0
PROXIMATE ANALYSIS (DRY BASIS)		
% Ash	48.7	33.2
% Volatile Matter	17.0	18.0
% Fixed Carbon	34.3	48.8
% Total Sulphur	0.2	0.3
BTU/LB (GROSS AIR DRIED)	8280	9360
BTU/LB (GROSS AS RECEIVED)	7900	8100
HARDGROVE GRINDABILITY	70.0	108.0
ULTIMATE ANALYSIS		
% Carbon	43.6	57.9
% Chlorine	--	--
% Hydrogen	2.7	3.4
% Nitrogen	0.6	0.6
% Sulphur	0.2	0.3
% Oxygen	4.3	4.7
% Ash	48.6	33.1
ASH ANALYSIS		
% Silicon - S_1O_2	63.5	60.2
% Aluminum - AL_2O3	27.5	28.9
% Iron - Fe_2O_3	3.8	3.9
% Calcium - CaO	0.8	2.7
% Magnesium - MgO	0.8	0.9
% Phosphorus- P_2O_5	0.2	0.2
% Sodium - Na_2O	0.1	0.1
% Potassium - K_2O	1.0	1.1
% Titanium - T_iO_2	1.1	1.1
% Sulphur - SO_3	0.7	1.2
% Undetermined	0.5	-0.3
ASH FUSION		
DEFORMATION TEMP DEG. C	1350	1300
HEMISPHERE TEMP DEG. C	1650	1610
FLOW TEMP DEG. C	1655	1635
SIZING		
2" + 3/4" WT%	33.5	16M=10.1
3/8 + 28M WT%	55.7	16X28M=14.4
28M + 100M WT%	6.5	28X100M=37.1
100M + 0 WT%	4.3	100M=38.4
	100%	100%

ASH FUSION TEMPERATURE:

	OXIDIZING	REDUCING
Initial Deformation - Deg. C	1500+	1500+
Softening - Deg. C	1500+	1500+
Hemispherical - Deg. C	1500+	1500+
Fluid - Deg. C	1500+	1500+

SCREEN ANALYSIS:

mm	Inches	% PASSING	% RETAINED
50.00	2	100.0	0.0
25.00	1	99.0	1.0
13.00	1/2	95.0	5.0
6.40	1/4	84.0	16.0
3.00	1/8	73.0	27.0
1.70	10 mesh	62.0	38.0
0.60	28 mesh	45.0	55.0
0.20	65 mesh	27.5	72.5
0.15	100 mesh	22.0	78.0
0.07	200 mesh	10.0	90.0

NOVEMBER 1984

ELKVIEW THERMAL COAL SPECIFICATIONS
TYPICAL LOADED AT ROBERTS BANK

PROXIMATE ANALYSIS:	AIR DRY BASIS	AS-RECEIVED BASIS
% Moisture	1.50	9.00
% Ash	13.50	12.50
% Volatile Matter	21.00	19.40
% Fixed Carbon	64.00	59.10
% Sulphur	0.40	0.37
Calories - gross cal/gm)	7,200	6,666
Btu - gross (btu/lb)	12,960	12,000
Hardgrove Grindability	80-90	

ULTIMATE ANALYSIS:	
% Carbon - C	75.50
% Chlorine - Cl_2	0.04
% Hydrogen - H	4.23
% Nitrogen - N	0.56
% Sulphur - S	0.39
% Oxygen - O	5.78
% Ash	13.50
	100.00

ASH ANALYSIS:	
% Silicon - SiO	62.20
% Aluminum - Al_2O_3	30.80
% Iron - Fe_2O_3	2.00
% Calcium - CaO	1.70
% Magnesium - MgO	0.50
% Phosphorus - P_2O_5	0.20
% Sodium - Na_2O	0.50
% Potassium - K_2O	0.30
% Titanium - TiO_2	1.00
% Sulphur - SO_3	0.60
% Undetermined	0.20
	100.00

LINE CREEK THERMAL COAL

COAL QUALITY

MOISTURE	DRY BASIS	AS-RECEIVED BASIS
Total %	-	8
Residual % (ad)	-	0.75
PROXIMATE ANALYSIS %		
Ash	15-17	14-16
Volatile Matter	21-22	19-20
Fixed Carbon	62-63	56-59
ULTIMATE ANALYSIS % (daf)		
Carbon	88.4	
Hydrogen	4.6	
Nitrogen	1.2	
Sulphur	0.4	
Oxygen (by diff.)	5.4	
Chlorine	0.02	
Gross calorific value kcal/kg	6800-7000	6250-7000
		11.430
Net calorific value kcal/kg	6600-6800	6050-6250
Btu/# (x 1.8)	12.060	11.070
Hardgrove grindability index	75	
Size, mm	50X0	
Ash fusion - I.D.T. (reducing)	1480°C+	

Ash analysis, Wt.%

SiO_2	59.55	K_2O	1.07
Al_2O_3	28.94	MgO	0.55
Fe_2O_3	3.82	Na_2O	0.38
TiO_3	1.56	SO_3	0.71
CaO	1.50	P_2O_5	0.66
		undet.	1.26

LINE CREEK THERMAL COAL

TYPICAL SIZE DISTRIBUTION

SIZE (mm)	WT.%
+50	0
50 X 25	3
25 X 12.5	7
12.5 X 6.0	12
6.0 X 2.0	22
2.0 X 0.6	26
0.6 X 0.15	19
-0.15	11

7.2 The coal purchase cost structure is as follows: A commodity price F.O.B. mine loaded into buyer's truck plus transportation to Libby, Montana. The following is a summary of the coal commodity prices received from two Canadian mines:

	(U.S. Dollars)		
	Thermal Coal		Refuse Coal
Mine	Crows Nest	Westar	Westar
Commodity price per short ton mine	$20.41 to 23.81	$19.00	$4.00
Loading and blending charge	included	included	1.50
F.O.B. truck price	$22.11	19.00	5.50
BTU per pound (as received)	11,430	12,000	8,000
Cost per million BTU	$0.967	$0.79	$0.34
Ash content	15%	12.5%	33%

7.3 The coal purchase term and contract conditions range from a spot purchase with a one-week notice to a 20-year long term contract. Because our coal purchase quantities are so small relative to the mine annual production, we can select the type of purchase contract that meets our needs. Two basic purchase contract types are suggested, either a spot market purchase or a long-term contract. The type of contract would be dependent upon whether coal is a back up fuel or a primary fuel. The spot purchase contract would be used when coal is the backup fuel for the waste wood fuel.

Spot market purchases would be on an individual truck load basis with the price set at the time of purchase. The spot market price would be a combination of the following factors: current commodity price, effort required by mine to load the small order, administrative cost, and benefit to mine for removing the refuse coal.

The long-term contract will have the following basic provisions: a base price of coal, a provision to escalate annually the labor, material and supplies, and fuel component of the base price using a relevant Canadian Index. Also, a provision to renegotiate the base price every five (5) years. A long-term coal contract will have the following basic outline:

1. Parties to Agreement
2. Definitions
3. Sale and Purchase Quantity
4. Term
5. Title - Risk of Loss
6. Price and Price Adjustments
7. Coal Quality
8. Terms of Payment
9. Force Majeure
10. Arbitration
11. Notice
12. Applicable Law

The following is a suggested outline for a long-term coal purchase contract as a fuel supply for the project:

1. Parties to Agreement: Rayson Brothers and the coal mine.
2. Definitions: as required
3. Sale and Purchase Quantity: 30,000 tons per year for cogeneration and 7,500 tons per year for dryer. Buyer to have option to vary quantity as used by W. R. Grace. (Buyer's customer).
4. Terms: 20 years
5. Title: the risk of loss should pass when the coal is placed in the buyer's truck.
6. Price and Price Adjustments: The price should be a F.O.B. Buyer's truck. The price adjustments should be different for thermal and refuse coal types. Thermal coal is a primary product, and its price adjustments would be based on labor, material and supplies using a relevant index. Refuse coal pricing structure should recognize the benefits to the mine and that this coal is a byproduct of the mine metallurgical coal production and the poor quality of the coal.
7. Coal Quality: will depend on the type of coal purchased. Thermal coal should have a very uniform quality, moisture, size distribution and heat content. The refuse coal will have a wide range of characteristics as recovered from the storage areas. To some degree, the mine can blend refuse coal, but this is limited by the quantities purchased, weather and coal in the refuse pile.
8. Terms of Payment: will be either on a bi-weekly or monthly basis.

9. Force Majeure: would provide for non-performance for events not under the control of the buyer and seller.
10. Arbitration: is a requirement because the coal purchase agreement can not take into account unforseen future events.
11. Notice: certified mail to designated address of the other party.
12. Applicable Law: can be an important issue in the event of a dispute. Because we are a small purchaser, the seller will probably dictate Canadian law.

8. Secure Current Coal Transport Data

Quotes were recieved from two regional contract haulers. Both haulers currently haul from Canada to the United States. The contract haulers contacted were ZERBEL and EXCEL.

The current hauling cost is 95 cents per operating mile plus $30.00 per load. This is for a minimum 24-ton load.

The cost to haul one load 110 miles from the mine to the project is: (110 miles x 2 x $0.95/mile + $30) $239/load or $9.96 per ton.

The maximum length of haul contract offered is five years. The haul contract would be patterned after long-term haul contracts with the forest products industry.

The long-term cost inflation would be based on cost changes in diesel fuel, tires, road taxes, replacement parts, equipment replacement and labor costs.

9.0 Fuel Supply Cost for Bioenergy and Coal

The following presents the calculated fuel supply systems cost performance for bioenergy and coal fuels:

9.1 Coal Supply Cost:

	Thermal Coal	Refuse Coal
Commodity $/ton FOB truck	$20.00	$ 4.00
Loading cost	-	1.50
F.O.B. truck at mine	$20.00	$ 5.50
110 mile haul cost	9.96	9.96
Cost/ton FOB mine	$29.96	$15.46
Fuel heat valve (BTU/pound as received)	11,750	8,000
Cost per million BTU	$ 1.27	$ 0.97
Annual Fuel used:		
Dryer	3608 tons	5300 tons
cost	$108,111.00	$81,938.00
Cogeneration	20,426 tons	30,000 tons
cost	$611,950.00	$463,000.00

9.2 Bioenergy Fuel Supply Cost

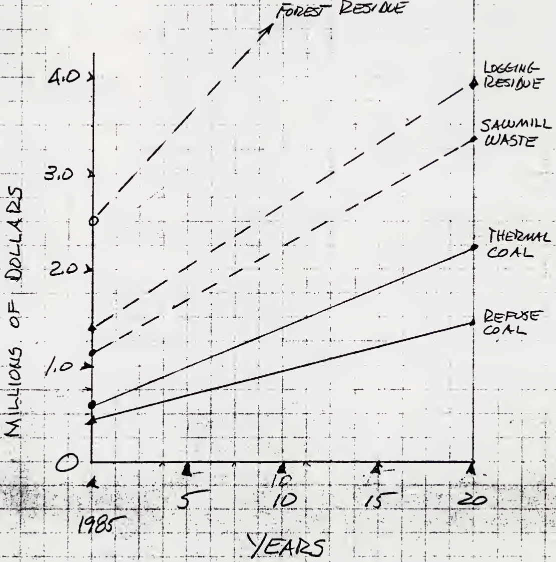
	Forest Residue	Logging Residue	Sawmill Waste
Commodity $/ton FOB truck	not applicable	not applicable	$2.00
Recovery cost	$25.00	$10.00	
Haul cost	5.00	5.00	ton 9.42 (1)
Cost FOB mine	$30.00	$15.00	ton $11.42
Processing & storage	2.00	2.00	2.00
Administration & management	2.00	2.00	2.00
Total per ton	$34.00	$19.00	$15.42
Heat content (BTU/lb as received)	4500	4500	4500
Cost per million BTU	$ 3.78	$ 2.11	$ 1.71
Annual fuel cost	$2,516,000	$1,406,000	$1,141,000

Note (1): For 74,000 TPY

The following presents a preliminary economic projection of the long-term cost performance of the three energy supply systems. A detailed economic projection will be prepared in the next milestone activity.

ANNUAL MINE FUEL BUDGET

ENERGY OPTION COMPARISON



NOTE: COST IS PURCHASE OF COMMODITY, FOB MINE, IT DOES NOT INCLUDE CONVERSION COSTS

Fuel Supply Cost Comparison
(20 year forecast)

Refuse Coal	1985	Annual Escalation	2004	
Commodity F.O.B. Truck	4.00	5%	10.61	
Loading Cost	1.50	7%	5.81	
Transport Cost	9.96	6%	31.94	
TOTAL	15.46		48.36	3.12
Cogen (30,000 tons)	($463,000)		($1,450,000)	
Thermal Coal				
Commodity	20.00	7%	77.39	
Transport Cost	9.96	6%	31.94	
TOTAL	29.96		109.33	3.65
Cogen (20,426 tons)	($611,950)		($2,233,000)	
Sawmill Waste				
Commodity	2.00	5%	5.31	
Transport	9.42	6%	30.21	
Processing	2.00	5%	5.31	
Administration	2.00	5%	5.31	
TOTAL	15.42		45.60	2.96
Cogen (74,000 tons)	($1,141,000)		($3,374,400)	
Logging Residue				
Recovery Cost	10.00	5%	26.53	
Haul Cost	5.00	6%	16.04	
Processing	2.00	5%	5.31	
Administration	2.00		5.31	2.80
TOTAL	19.00		53.19	
cogen	($1,406,000)		($3,936,060)	
Forest Residue				
Recovery Cost	25.00	5%	66.33	
Haul Cost	5.00	6%	16.04	
Processing Cost	2.00	5%	5.31	
Administration	2.00		5.31	
TOTAL	34.00		92.99	
	($2,516,000)		($6,881,000)	

BIOENERGY FUEL SUPPLY COSTS

(Sawmill Wood Waste)

		Dryer Only		Total Mine
Annual Tons		12,000		74,000
Cost Delivered to Libby				
Sawmill Commodity	ton	$ 2.00	ton	$ 2.00
Transportation		$ 3.50		$ 6.80
Subtotal		$ 5.50		$ 8.80
Processing and Storage		$ 5.00		$ 1.88
Haul to Top of Hill		$ 5.00		$ 0.81
Subtotal		$15.50		$11.49
Administration and Management		$ 4.00		$ 2.00
Subtotal	ton	$19.50	ton	$13.49
Energy Conversion Facilities (1)		$12.58		$15.57
Total Wood	ton	$32.08	ton	$29.06
$/million BTU @ 9mm BTU/ton		$ 3.56		$ 3.23
Wood Equivalent Price to Oil				
Current Oil	MBTU	4.49	= ton	$40.41
Wood/Coal Cost Ratio				(79%)
(72%)				
		$384,960		$2,150,440

Note (1): Amortization of Capital investment.

MILL WASTE SUPPLY TRANSPORTATION COST

					Transportation Cost (1)		
#	Supplier	One-Way Miles	Tons	Cumulative Total	$	Cumulative Total	$/ton
1.	Henson	18	2500	2500	6687	6687	$ 2.68
2.	Lienco	18	2500	5000	6687	13374	2.68
4.	L & L	18	1500	6500	4013	17387	2.68
21.	L.P.	40	15000	21500	66250	83637	3.89
17.	Harley	58	1500	23000	8763	92400	4.02
18.	Byler	58	1500	24500	8763	101163	4.13
19.	Dettwiller	58	3125	27625	18255	119418	4.32
16.	Vinson	78	10000	37625	74250	193668	5.15
26.	Crestbrook	82	15000	52625	116125	309793	5.89
27.	Yank	88	10000	62625	82167	391960	6.26
13.	Flodin	90	5600	68225	46900	438860	6.43
9.	Idaho Timber	102	10000	78225	93250	532110	6.80
23.	Crestbrook	132	90000	168225	1053000	1585110	9.92
			168225				
11.	Tricity	89	60000 (2)		497250		8.30

Note (1): Assume 24 ton average tons, $30 to load and unload plus $0.95 per truck mile hauled.

(2): Large pile - 10-20 acres of slabs and sawdust. Sawmill not operating at this time.

C. List of References

- Mill Residue Availability in the Inland Empire Charles E. Keegan and Timothy P. Jackson, Bureau of Business and Economic Research, University of Montana, Missoula, Montana, 1984.
- Montana Logging Residue Inventory. Bureau of Business and Economic Research, University of Montana, Missoula, Montana, 1984.
- Excel Transport, Mr. Dean Wood, Lewiston, Idaho.
- Keegan, C. E., T. P. Jackson, and A. E. Chase, 1984, Cost and Available Volumes of Forest Residue in the Libby, Montana Area, Bureau of Business and Economic Research, University of Montana, Missoula.
- Combes, John, 1984, Personal Communication, U.S. Forest Service, Region 1, Wood Energy Coordinator and Assistant Director, Timber Management.
- Keegan, C.E. and T.P. Jackson, 1984, Mill Residue Availability in the Inland Empire, Bureau of Business and Economic Research, University of Montana, Missoula.

204: Secure and/or prepare drafts of energy supply agreements between W. R. Grace, Rayson Brothers and the potential coal fuel suppliers. Conduct exploratory contract discussions with the coal supplier and Rayson Brothers Logging Co.

Product: Draft fuel supply contracts.

A: TASK REPORT TABLE OF CONTENTS

1. Introduction
2. Purpose and Task Description
3. Secure draft Coal Supply Agreement from coal supplier
4. Prepare draft Energy Supply Agreement between W. R. Grace and Rayson Brothers
5. Prepare draft Mill Waste Supply Agreement between Rayson Brothers and sawmills
6. Prepare draft Forest Residue Agreement between Rayson Brothers and Forest owner or manager
7. Conduct preliminary contract discussions with coal supplier
8. Conduct preliminary contract discussions between Rayson Brothers and W. R. Grace
9. Conduct preliminary contract discussions between Rayson Brothers and USFS
10. Revise Draft Fuel Supply Agreements
11. Draft Long-term Fuel Hauling Contracts

B. LIST OF REFERENCES

- Ken Briggeman, Kootenai National Forest, U. S. National Forest Service, Libby, Montana.

- Northern Idaho Biomass Cogeneration Feasibility Study, State of Idaho Department of Water Resources Contact #DWR-83-03-81-103-8, Prepared by D. G. Van Hersett, P.E., Resource Development Associates, Spokane, Washington.

DRAFT AGREEMENT

LIBBY BIOENERGY PROJECT
PRIMARY WASTE WOOD FUEL SUPPLY AGREEMENT

THIS AGREEMENT is made this _____ day of _____, 19___, between Libby Energy Service Company, Inc. ("Buyer") and Rayson Brothers Logging Company, Inc., a Montana, corporation ("Seller").

RECITALS:

WHEREAS, Buyer has been formed to construct a facility to generate electricity; and

WHEREAS, Buyer is in need of a guaranteed supply of wood waste to fuel its energy production facilities in order to meet its commitments under a contract with W. R. Grace & Company, and

WHEREAS, Seller wants to sell its waste wood to Buyer through the establishment of Buyer as a continuing waste wood user;

NOW, THEREFORE, in consideration of the premises, convenants and conditions hereunder, and other good and valuable consideration, the parties agree as follows:

1. Definitions. The following terms, when used in this Agreement, shall have the following meanings:

1.1 "Material balance" shall be defined as an analysis of the estimated annual production of mill waste produced at sawmills contracted to Seller as a by-product of lumber production.

1.2 "Mill waste" shall be defined as waste delivered within 30 days of manufacture, maximum moisture content 50% on a wet basis or as inherent moisture in the wood waste material and reasonably free of foreign materials such as rocks and metal. Typical mill waste includes bark, sawdust and all other mill waste produced at Seller's facilities. The mill operator shall use reasonable effort to minimize the use of water in the sawmill operations to minimize the moisture content added to the mill waste. Mill waste shall be capable of being loaded into traditional chip vans at the sawmill location. The size distribution of the mill waste shall allow chip vans to be loaded to capacity in volume and/or weight. In the event the mill waste size distribution prohibits economic loading and transportation by the buyer, the Seller shall be responsible to prepare the mill waste to allow the Seller to economically handle and transport the Seller's mill waste. Mill waste quantities and types shall be identified in Seller's Material Balance attached hereto as Exhibit "A".

1.3 "Log deck debris" and "yard waste" shall be defined as waste produced at a sawmill other than mill waste, and is not included in a sawmill's material balance.

1.4 "Logging residue" shall be defined as slash and unmerchantable timber that is left in the forest after logging operations have been conducted there.

1.5 "Forest residue" shall be defined as unmerchantable waste logs and other products discarded in the forest as a result of thinning or forest fire and which otherwise do not fall within the classification of mill waste, log deck debris, yard waste or logging residue.

1.6 "Wood waste" shall be defined as mill waste, log deck debris, and yard waste, all processed and prepared to three inches minus in size and reasonably free of foreign materials such as rocks and metal. The average annual maximum moisture content shall be less than 50 percent on a unit basis or as inherent moisture in the wood waste material. The Seller shall use reasonable care to minimize moisture of wood waste delivered.

2. Wood Waste. Seller shall sell to Buyer and Buyer shall purchase from Seller, on an annual basis, _______ tons of wood waste per year, subject to the provisions of Paragraph 11. Said wood waste shall meet the specifications set forth in Paragraph 7.

3. Term. This Agreement shall be effective on the date of execution and shall continue to that date which is ______ years from the date that is the last day of the month following the first delivery of waste wood under this Agreement. Deliveries shall commence when Buyer's fuel handling and storage facilities are ready and Buyer determines it is able to receive wood waste from the Seller, which is now projected to be on or about December 31, 1985.

This Agreement shall automatically extend year to year at the end of the initial term and each succeeding annual term unless notice to the contrary is given by either party to the other party six months prior to the expiration of the preceding term.

4. Purchase Price. Buyer shall pay to Seller the higher of __________per ton for wood waste. The price shall change at the same annual rate that the Buyer's Energy Sales Agreement changes.

5. Payment. Buyer shall pay the purchase price to Seller within 30 days following the acceptance of the wood waste by Buyer. Payment may be mailed to Seller's address specified in Section 16 below, and if so mailed, will be deemed paid when posted.

6. Quantity. Seller shall provide and annually revise a 5-year wood waste delivery forecast. Seller's initial 5-year forecast shall be presented to Buyer on the date of the execution of this Agreement and revised annually thereafter. Seller shall promptly notify Buyer of anticipated annual quantity changes in excess of plus or minus 20% of the annual plan. Notwithstanding the Seller's notification to Buyer of anticipated annual changes, the Seller is not relieved of its obligations to supply the amount of waste wood commited hereunder.

7. Measurement and Specifications.

7.1 The unit of measurement of wood waste shall be the ton, which equals 2,000 pounds of wood waste. The measurement of tons shall be at Buyer's weighing facilities or at a weighing station designated by Buyer. Buyer shall determine the weight of each load of wood waste delivered by weighing the loaded vehicle and deducting the tare weight. In the event of the breakdown of Buyer's weighing or receiving facilities, Buyer may estimate load weights at Buyer's facilities or use the average of Seller's most recent loads. Seller may, at reasonable times and at Seller's expense, inspect Buyer's measurement procedures and records.

7.2 Wood waste supplied by Seller shall conform to the specifications set forth in Paragraph 1 of this Agreement.

8. Inspection and Rejection. Any truck load of wood waste not meeting the above specifications may be rejected by Buyer with disposal costs assigned to Seller. Seller will be notified promptly of failure of wood waste to meet specifications and will be given an opportunity to communicate disposal instructions to Buyer.

9. Shipment Terms.

9.1 Except as otherwise provided in this Agreement, the Seller shall supply the vehicle to be used for shipment of the wood waste and transport the wood waste to Buyer's facilities. The parties may agree that Buyer shall supply the vehicle to be used for shipment. In any event, the risk of loss for each individual load passes from Seller to Buyer when the wood waste is accepted by Buyer.

9.2 The rate of reimbursement to the Seller provided in Paragraph 9.2 shall be subject to adjustment on the date that is one year from the first date of delivery of wood waste under this Agreement, and on each and every anniversary thereafter (the "Adjustment Date").

10. Loading and Unloading.

Buyer shall provide suitable fuel receiving facilities to accommodate designated fuel delivery systems and vehicles. Wood waste deliveries loaded for transportation to Buyer's energy facilities shall be capable of unloading and handling by Seller's facilities. The unloading schedule shall be determined by Buyer and Buyer may designate alternate unloading destinations.

11. Curtailment or Discontinuance.

11.1 If Seller should shut down or discontinue the operation of its plant, or if Buyer should shut down or discontinue the operation of its consuming generating plant so as to affect Buyer's use of wood waste purchased by or delivered pursuant hereto, for any reason that may be considered sufficient to justify such action, Seller or Buyer, as the case may be, shall not be liable in any manner for failing to deliver or refusing to accept wood waste during the period of such shutdown or discontinuance. However, if such refusal to accept or failure to deliver shall continue for a longer period than ninety (90) days, the other party may, at its option, seek damages from the non-performing party limited to the cost of disposal or replacement of such waste wood. To the extent the Seller fails to deliver wood waste, no payments will be due to Seller for undelivered fuel, and the Buyer shall be free to purchase necessary fuel to cover the discrepancy created by non-performance by the Seller. To the extent the cost of fuel purchased exceeds amounts that would have been paid to the Seller, the Seller shall be responsible for reimbursing the Buyer for the difference. Failure to meet delivery commitments will result in the Seller's forfeiture of this Agreement. The Buyer, at its option, may terminate this Agreement by giving the non-performing party ten (10) days written notice of such termination.

11.2 If, for any such sufficient reason, Seller should curtain the operation of its fuel supply operation, Seller shall continue to deliver such reduced quantity of wood waste as it may. However, if Seller's deliveries of such reduced quantities of wood waste shall continue for a longer period than sixty (60) days and the quantity so delivered to Buyer is less than 50 percent of the maximum Buyer is required to accept in any two calendar months pursuant to Paragraph 2 hereof, then and in that even Buyer may at its option terminate this Agreement by giving the Seller ten (10) days notice in writing of such termination or shall be free to contract the fuel supply deficiency with another party. The Seller shall reimburse the Buyer any extra costs incurred to secure another agreement for the remainder of the contracted term. The Seller's liability shall be limited to the gross revenue that would have been paid by the Buyer to the Seller. The Seller shall have the option to arrange for replacement wood waste subject to approval by and at the option of the buyer.

11.3 If, for any such sufficient reason, Buyer should curtail the operation of such energy plant, Buyer expects to be able to unload, process or store in its then available and unused storage facilities, then Buyer, at its option, by giving to Seller not less than ten (10) days notice in writing, and without liability, may reduce the number of units of wood waste which it is required to take under the terms of this Agreement proportionately to the percentage of curtailments.

11.4 If, as a consequence of curtailment, shutdown or discontinuance of the operation of Buyer's generating plant, Buyer should elect to curtail or discontinue its taking of wood waste hereunder, Seller shall have the right during any such period of curtailment or discontinuance, to sell to others that volume of wood waste which Buyer does not take during such period; provided, however, that promptly upon resumption of full wood waste consumption by Buyer's energy plant, Seller shall deliver to Buyer the Seller's entire wood waste production up to the maximum number of units that Buyer may be required to take under Paragraph 2 hereof. The curtailing party or the party shutting down or resuming production or consumption shall give to the other party prompt and appropriate written notice setting forth all information which reasonably would appear to be helpful in rescheduling and readjusting the other party's operations.

11.5 In the event the Buyer's facility is curtailed by the utility purchasing power and should the utility compensate the Buyer for curtailing production, the Buyer shall include the Seller's incremental costs in the curtailment compensation changes charged by the Buyer to the utility. Should the Seller not be affected by the curtailment, no compensation shall be due to the Seller.

12. Negotiations. The parties hereunder acknowledge that Buyer is currently in the process of negotiating a contract with Pacific Power and Light Co. for the purchase of the electricity generated at its facilities. Also, the Buyer is currently in the process of negotiating a fixed price turnkey contract to construct Buyer's generating facility, licensing the generating facility, and securing financing for the Buyer's generating facility. The parties further agree that the obligations of each party hereunder are subject to the final, executed contract between Buyer and Pacific Power and Light Co., Construction Contractor, Construction and operating permits and project financing.

13. Default. Should either party default in the performance of its obligations under this Agreement, including, but not limited to , the obligation to deliver wood waste in accordance with the specifications set forth above in Section 6, then the non-defaulting party may terminate this Agreement by giving thirty (30) days written notice to the defaulting party. In the event that either party should be adjudicated as bankrupt, in the case of either party's insolvency (in either the equity or balance

sheet sense), or if a receiver should be appointed for either party, then the other party, without previous notice and without liability, may immediately either suspend or terminate its obligations under the Agreement, provided that written notice of such suspension or termination is given to such party as soon as practical thereafter.

14. Assignment. This Agreement shall accrue to the benefit of and be binding upon the parties hereto, together with their respective heirs, successors, executors and administrators, or assigns, but this Agreement shall not be assignable by either party without prior written consent of the other party.

15. Force Majeure.

15.1 If, because of force majeure, any party shall be unable to carry out any of its obligations under this Agreement, then the obligations of such party shall be suspended to the extent made necessary by such force majeure. The affected party shall give notice to the other party as promptly as practicable of the nature and probable duration of such force majeure.

The term "force majeure" shall be defined as, but not limited to, acts of God, legislation or lawful regulations of any government or govenment agency, court orders, acts of a public enemy, riots, fires, volcanic eruptions, explosions, floods, interruptions in transportation or other causes of similar nature, breakdowns or damage to plants, transmission lines, equipment or facilities, interruptions in transportation or other causes of a similar nature which wholly or partially prevent the delivery of the wood waste by Seller, the receiving or consuming of the wood waste by Buyer, or the construction, operation or maintenance of Buyer's generating facilities. Buyer and Seller shall use all reasonable means of preventing the occurrence of any of the foregoing over which they have control.

15.2 In the event any Seller's facilities are damaged upon the occurrence of any of the events listed in Subparagraph 15.1, or any other breakdown of Seller's facilities, Seller shall give Buyer immediate notification thereof. If the nature and extent of damage prevents Seller from meeting its obligations under this Agreement, Seller shall commence repair of its facility as soon as practicable, and shall thereafter prosecute such work with due diligence. During the time of repair, the Seller's obligations under this Agreement are suspended.

16. Notices. Any notice required to be given by one party to the other under this Agreement or by law shall be effectively given on the date of personal delivery, or if mailed, three days after deposit in the United States mail, first class, postage prepaid, certified or registered, and addressed as follows:

If to Buyer: ______________________________

____

____

If to Seller: ______________________________

____

____

17. Attorney's Fees. In the event that any party shall bring an action in connection with the performance, breach or interpretation of this Agreement, or in any way relating to the transactions contemplated hereby, the prevailing party in such action shall be entitled to recover from the losing party all reasonable costs and expenses of litigation, including attorney's fees, court costs, costs of investigation, accounting, and other costs reasonably related to such litigation, in such amounts as may be determined in the sole discretion of the court having jurisdiction over the action.

18. Governing Law. This Agreement shall be construed and interpreted in accordance with the laws of the State of Montana.

The parties hereto executed this Agreement in duplicate on the day and year first written above.

______________________________	______________________________
By: ______________________________	By: ______________________________
Title: ______________________________	Title: ______________________________
"Seller"	"Buyer"

DRAFT AGREEMENT

LIBBY BIOENERGY PROJECT
WASTE WOOD FUEL SUPPLY AGREEMENT

THIS AGREEMENT is made this _____ day of _________, 19___, between ____("Buyer") and Rayson Brothers Logging Company, Inc., a Montana, corporation ("Seller").

RECITALS:

WHEREAS, Buyer has been formed to construct a facility to generate electricity; and

WHEREAS, BUYER IS IN NEED OF A GUARANTEED SUPPLY OF WOOD WASTE TO FUEL ITS ENERGY FACILITIES, AND

WHEREAS, Seller wants to sell its waste wood to Buyer through the establishment of Buyer as a continuing waste wood user;

NOW, THEREFORE, in consideration of the premises, covenants and conditions hereunder, and other good and valuable consideration, the parties agree as follows:

1. Definitions. The following terms, when used in this Agreement, shall have the following meanings:

1.1 "Material balance" shall be defined as an analysis of the estimated annual production of mill waste produced at sawmills contracted to Seller as a by-product of lumber production.

1.2 "Mill waste" shall be defined as waste delivered within 30 days of manufacture, maximum moisture content 50% on a wet basis or as inherent moisture in the wood waste material and reasonably free of foreign materials, such as rocks and metal.

Typical mill waste includes bark, sawdust and all other mill waste produced at Seller's facilities. The mill operator shall use reasonable effort to minimize the use of water in the sawmill operations to minimize the moisture content added to the mill waste. Mill waste shall be capable of being loaded into chip vans at the sawmill location. The size distribution of the mill waste shall allow chip vans to be loaded to capacity in volume and/or weight. In the event the mill waste size distribution prohibits economic loading and transportation by the Buyer, the Seller shall be responsible for preparing the mill waste to allow the Seller to economically handle and transport the Seller's mill waste. Mill waste quantities and types shall be identified in Seller's Material Balance attached hereto as Exhibit "A".

1.3 "Log deck debris" and "yard waste" shall be defined as waste produced at a sawmill other than mill waste, and is not included in a sawmill's material balance.

1.4 "Logging residue" shall be defined as slash and unmerchantable timber which is left in the forest after logging operations have been conducted therein.

1.5 "Forest residue" shall be defined as unmerchantable waste logs and other products which otherwise do not fall within the classification of mill waste, log deck debris, yard waste or logging residue.

1.6 "Wood waste" shall be defined as mill waste, log deck debris, and yard waste.

2. Wood waste Seller shall sell to Buyer and Buyer shall purchase from Seller, on an annual basis, ____________ tons of wood waste per year, subject to the provisions of Paragraph 11. Said wood waste shall meet the specifications set forth in Paragraph 7.

3. Term. This Agreement shall be effective on the date of execution and shall continue to that date which is ________ years from the date which is the last day of the month following the first delivery of waste wood under this Agreement. Deliveries shall commence when Buyer's fuel handling and storage facilities are ready and Buyer determines it is able to receive wood waste from the Seller, which is now projected to be on or about December 31, 1985. This Agreement shall automatically extend year to year at the end of the initial term and each succeeding annual term unless notice to the contrary is given by either party to the other party six months prior to the expiration of the preceding term.

4. Purchase Price. Buyer shall pay to Seller the higher of __________ per ton for wood waste. The price shall change at the same annual rate that the Buyer's Energy Sales Agreement changes.

5. Payment. Buyer shall pay the purchase price to Seller within 30 days following the acceptance of the wood waste by Buyer. Payment may be mailed to Seller's address specified in Section 16 below, and, if so mailed, will be deemed paid when posted.

6. Quantity. Seller shall provide and annually revise a 5-year wood waste delivery forecast. Seller's initial 5-year forecast shall be presented to Buyer on the date of the execution of this Agreement and revised annually thereafter. Seller shall promptly notify Buyer of anticipated annual quantity changes in excess of plus or minus 20% of the annual plan. Notwithstanding the Seller's notification to Buyer of anticipated annual changes, the Seller is not relieved of its obligations to supply the amount of waste wood commited hereunder.

7. Measurement and Specifications.

7.1 The unit of measurement for wood waste shall be the ton, which equals 2,000 pounds of wood waste. The measurement of tons shall be at Buyer's weighing facilities or at a weighing station designated by Buyer.

Buyer shall determine the weight of each load of wood waste delivered by weighing the loaded vehicle and deducting the tare weight. In the event of the breakdown of Buyer's weighing or receiving facilities, Buyer may estimate load weights at Buyer's facilities or use the average of Seller's most recent loads. Seller may, at reasonable times and at Seller`s expense, inspect Buyer's measurement procedures and records.

7.2 Wood waste supplied by Seller shall conform to the specifications set forth in Paragraph 1 of this Agreement.

7.3 Buyer shall assist Seller in determining the specifications and acceptability of unusual or unprepared wood waste. Buyer will accept log deck debris and yard waste providing that the parties agree on a mutually acceptable preparation and handling method and Buyer is capable of acceptance of any volume of unprocessed waste wood. The decision to accept unusual or unprepared wood waste rests solely with Buyer. The estimated quantity for log deck debris and yard waste is __________ tons per year.

8. Inspection and Rejection. Any truck load of wood waste not meeting the above specifications may be rejected by Buyer with disposal costs assigned to Seller. Seller will be notified promptly of failure of wood waste to meet specifications and will be given an opportunity to communicate disposal instructions to Buyer.

9. Shipment Terms.

9.1 Except as otherwise provided in this Agreement, the Seller shall supply the vehicle to be used for shipment of the wood waste and transport the wood waste to Buyer's facilities. The parties may agree that Buyer shall supply the vehicle to be used for shipment. In any event, the risk of loss for each individual load passes from Seller to Buyer when the wood waste is accepted by Buyer.

9.2 The rate of reimbursement to the Seller provided in Paragraph 9.2 shall be subject to adjustment on the date which is one year from the first date of delivery of wood waste under this Agreement, and on each and every anniversary thereafter (the "Adjustment Date").

10. Loading and Unloading.

10.1 Buyer shall provide suitable fuel receiving facilities to accommodate designated fuel delivery systems and vehicles. Wood waste deliveries loaded for transportation to Buyer's energy facilities shall be capable of unloading and handling by Seller's facilities. The unloading schedule shall be determined by Buyer and Buyer may designate alternate unloading destinations.

10.2 If the parties designate a Buyer vehicle to be used for the transfer of the wood waste, Seller shall provide access to Seller's facilities and loading for the Buyer designated vehicles. Seller shall further provide on-site storage and loading facilities to promptly load the vehicles designated by Buyer to maximum capacity in accordance with the carrier specifications.

10.3 For mill waste delivered to Buyer's designated vehicles at the Seller's sawmill, the Seller and the Buyer agree to cooperate in all arrangements necessary to minimize the cost to each party to provide on-site sawmill waste wood storage. Loading systems shall consist of a ground storage and consisting of an L-shaped lumber constructed with logs. The sawmill's front-end loader will be used to load the designated vehicles. In the event the size distribution of the mill waste will not allow standard chip vans to be economically loaded to capacity, the Buyer and Seller shall develop a mutually acceptable method to prepare the sawmill waste wood for satisfactory loading. The Buyer shall be responsible for new equipment purchase costs. The Seller shall be responsible for installation, operating and maintenance costs.

11. Curtailment or Discontinuance.

11.1 If Seller should shut down or discontinue the operation of its plant, or if Buyer should shut down or discontinue the operation of its consuming generating plant so as to affect Buyer's use of wood waste purchased by or delivered pursuant hereto, for any reason that may be considered sufficient to such acting party to justify such action, Seller or Buyer, as the case may be, shall not be liable in any manner for failing to deliver or refusing to accept wood waste during the period of such shutdown or discontinuance; provided, however, if such refusal to accept of failure to deliver shall continue for a longer period than ninety (90) days, the other party may, at its option, seek damages from the non-performing party limited to the cost of disposal or waste. No payments will be due to Seller for undelivered fuel and the Buyer shall be free to purchase necessary fuel to cover the discrepancy created by non-performance by the Seller. To the extent the cost of fuel purchased exceeds amounts that would have been paid to the Seller, the Seller shall be responsible for reimbursing the Buyer for the difference. Failure to meet delivery commitments will result in the Seller's forfeiture of this Agreement. The Buyer, at its option, may terminate this Agreement by giving the non-performing party ten (10) days written notice of such termination.

11.2 If, for any such sufficient reason, Seller should curtail the operation of its fuel supply operation, Seller shall continue to deliver such reduced quantity of wood waste as it may; provided, however, if Seller's deliveries of such reduced quantities of wood waste shall continue for a longer period than sixty (60) days and the quantity so delivered to Buyer is less than 50 percent of the maximum Buyer is required to accept in any two calendar months pursuant to Paragraph 2 hereof, then and in that event Buyer may, at its option, terminate this Agreement by giving the Seller ten (10) days notice in writing of such termination or shall be free to contract the fuel supply deficiency with another party. The Seller shall reimburse the Buyer any extra costs incurred to secure another agreement for the remainder of the contracted term. The Seller's liability shall be limited to the gross revenue that would have been paid by the Buyer to the Seller. The Seller shall have the option to arrange for replacement wood waste subject to approval by and at the option of the Buyer.

11.3 If, for any such sufficient reason, Buyer should curtail the operation of such energy plant, Buyer expects to be able to unload, process or store in its then available and unused storage facilities, then Buyer, at its option, by giving to Seller not less than ten (10) days notice in writing, and without liability, may reduce the number of units of wood waste which it is required to take under the terms of this Agreement proportionately to the percentage of curtailment; provided, however, if Buyer is purchasing wood waste from more than one supplier, reductions as between suppliers shall be made substantially prorata based on a average volume of wood waste delivered by each supplier to Buyer during the last three normal operating months immediately prior to the reduction.

11.4 If, as a consequence of curtailment, shutdown or discontinuance of the operation of Buyer's generating plant, Buyer should elect to curtail or discontinue its taking of wood waste hereunder, Seller shall have the right during any such period of curtailment or discontinuance, to sell to others that volume of wood waste which Buyer does not take during such period. However promptly upon resumption of full wood waste consumption by Buyer's energy plant, Seller shall deliver to Buyer the Seller's entire wood waste production up to the maximum number of units that Buyer may be required to take under production or consumption and shall give to the other party prompt and appropriate written notice setting forth all information which reasonably would appear to be helpful in rescheduling and readjusting the other party's operations.

11.5 In the event the Buyer's facility is curtailed by the utility purchasing power and should the utility compensate the Buyer for curtailing production, the Buyer shall include the Seller's incremental costs in the curtailment compensation changes charged by the Buyer to the utility. Should the seller not be affected by the curtailment, no compensation shall be due to the Seller.

12. Negotiations. The parties hereunder acknowledge that Buyer is currently in the process of negotiating a contract with Pacific Power and Light Co. for the purchase of the electricity generated at the energy facility. Also, the Buyer is currently in the process of negotiating a fixed price turnkey contract to construct Buyer's energy facility, licensing the facility, and securing financing for the Buyer's facility.

The parties further agree that the obligations of each party hereunder are sugject to the final, executed contract between Buyer and Pacific Power and Light Co., Construction Contractor, Construction and operating permits and project financing.

13. Default. Should either party default in the performance of its obligations under this Agreement, including, but not limited to, the obligation to deliver wood waste in accordance with the specifications set forth above in Section 6, then the non-defaulting party may terminate this Agreement by giving thirty (30) days written notice to the defaulting party. In the event that either party should be adjudicated as bankrupt, in the case of either party's insolvency (in either the equity or balance sheet sense), or if a receiver should be appointed for either party, then the other party, without previous notice and without liability, may immediately either suspend or terminate its obligations under the Agreement, provided that written notice of such suspension or termination is given to such party as soon as practical thereafter.

14. Assignment. This Agreement shall accrue to the benefit of and be binding upon the parties hereto, together with their respective heirs, successors, executors and administrators, or assigns, but this Agreement shall not be assignable by either party without prior written consent of the other party.

15. Force Majeure.

15.1 If, because of force majeure, any party shall be unable to carry out any of its obligations under this Agreement, then the obligations of such party shall be suspended to the extent made necessary by such force majeure. The affected party shall give notice to the other party as promptly as practicable of the nature and probable duration of such force majeure.

The term "force majeure" shall be defined as, but not limited to, acts of God, legislation or lawful regulations of any government or government agency, court orders, acts of a public enemy, riots, fires, volcanic eruptions, explosions, earth quakes, floods, interruptions in transportation or other causes of similar nature, breakdowns or damage to plants, transmission lines, equipment or facilities, interruptions in transportation or other causes of a similar nature which wholly or partially prevent the delivery of the wood waste by Seller, the receiving or consuming of the wood waste by Buyer, or the construction, operation or maintenance of Buyer's generating facilities. Buyer and Seller shall use all reasonable means of preventing the occurrence of any of the foregoing of which they might have control.

15.2 In the event any Seller's facilities are damaged upon the occurrence of any of the events listed in Subparagraph 15.1, or any other breakdown of Seller's facilities, Seller shall give Buyer immediate notification thereof. If the nature and extent of damage prevents Seller from meeting its obligations under this Agreement, Seller shall commence repair of its facility as soon as practicable, and shall thereafter prosecute such work with due diligence. During the time of repair, the Seller's obligations under this Agreement are suspended.

16. Notices. Any notice required to be given by one party to the other under this Agreement or by law shall be effectively given on the date of personal delivery, or if mailed, three days after deposit in the United States mail, first class, postage prepaid, certified or registered, and addressed as follows:

If to Buyer: ____________________________

____

____

If to Seller: ____________________________

____

____

17. Attorney's Fees. In the event that any party shall bring an action in connection with the performance, breach or interpretation of the Agreement, or in any way relating to the transactions contemplated hereby, the prevailing party in such action shall be entitled to recover from the losing party all costs, costs of investigation, accounting, and other costs reasonably related to such litigation, in such amounts as may be determined in the sole discretion of the court having jurisdiction over the action.

18. Governing Law. This Agreement shall be construed and interpreted in accordance with the laws of the State of Montana.

The parties hereto executed this Agreement in duplicate on the day and year first written above.

______________________________	______________________________
By:___________________________	By:___________________________
Title:________________________	Title:________________________
"Seller"	"Buyer"

-EXHIBIT "A"-

Seller's Material Balance

MEMORANDUM

TO: Chuck Keegan, Ken Briggeman (w/o attachments)

FROM: Dave Van Hersett

SUBJECT: Task 204: Forest Residue Draft Agreement

DATE: November 30, 1984

To complete Phase II work on Residue Rights, an outline of a negotiated contract for stand conversions for small tracts is desirable. Attached is a copy of Ken Briggeman's discussion on alternative methods for obtaining rights to residue on National Forest land.

General:

Phase I results indicate that we have the following methods to secure rights to forest residue:

- Obtain rights from timber sales purchases
- Contract thinning for forest owner/manager
- Contract stand conversion for forest owner/manager

Your task is to work with Ken to develop a draft outline of a negotiated contract that includes the following:

- For a defined tract of stagnated lodgepole pine identified in Phase 1
- Select and estimate the recoverable tonnage for a tract of your choice
- Term of agreement
- Road access conditions
- Stand conversion prescription
- Stand conversion payment/allowance

In developing the draft we should use the documents provided by Ken. These are attached for your use.

Second Task: Private Land Owner Residue Agreement

As an alternative, Clayton should contact a small, private land owner to secure the rights to forest residue. Please outline an agreement that would provide rights over a ten year term to forest residue as may be required by Clayton. The plan would be for Clayton to either log or thin a stand with the owner receiving all merchantable sawlogs and Clayton all residue.

Task Completion Date: December 15, 1984

Please call if you have any questions.

LONG-TERM FUEL HAULING CONTRACT

THIS AGREEMENT made and entered into this ______ day of __________, 19___, between ________________________ hereinafter referred to as the "Carrier," and Rayson Brothers Logging Company, a Montana Corporation, hereinafter referred to as "Customer",

WHEREAS, the Carrier owns a fleet of trucks, tractors and trailers and supplemental equipment and is equipped to handle truck transportation for products to be hereinafter described and is engaged in the business of a carrier by truck, and

WHEREAS, Customer purchases sawmill wastewood and manufactures it into energy, and

WHEREAS, the Carrier desires to contract for the transportation for wastewood to be herein described, which service is necessary and desirable to Customer, and

In consideration of the mutual covenants, agreements and payments to be made, agree as follows:

THE CARRIER AGREES:

1. To load, transport and unload, together with other carriers contracted for or owned by Customer, wastewood to be described from the point of origin to the point of destination and at the rates as set forth in Exhibit "A".

2. The quantity of the product to be transported by the Carrier will be solely dependent upon Customer's need thereof.

3. To furnish all necessary trucks, tractors, trailers and other supplemental equipment, together with its own drivers and personnel necessary for the full, faithful and prompt performance of the service to be rendered.

4. To pay all damage to Customer's property resulting directly or indirectly from the negligent act or omission of Carrier hereunder, and to procure and maintain at all times during this Agreement, in full force and effect, insurance as follows:

   (a) Carrier Cargo Liability Insurance;
   (b) Workmen's compensation insurance for every man in Carrier's employ;
   (c) Comprehensive general liability insurance, including but not limited to coverage upon cars, trucks, tractors, trailers, and any mobile equipment which shall provide for a limit for a single occurrence of not less than $1 million for all damages arising out of bodily injuries to or death of any person, and for a limit of not less than $100,000 for all

damages to or destruction of property during the policy period, and to furnish a certificate of insurance to Customer disclosing said policies to be in existence with endorsement thereon requiring the insurer to give thirty (30) days prior written notice to Customer of the expiration of, or any extension, modification or cancellation of such insurance.

5. To require its employees, while within the plant premises of Customer or its supplier, to comply with all fire, safety and traffic rules and regulations appertaining to said premises.

6. To comply with all federal, state and municipal laws and all rules, orders and regulations of any governmental agency applicable to Carrier's operations, including but not limited to rules and regulations and statutes of any concerning Interstate Commerce Commission and the Montana Public Utilities Commission.

7. To indemnify and hold harmless Customer against all claims or liabilities asserted by third parties including all governmental agencies resulting directly or indirectly from Carrier's acts or omissions hereunder, whether matured or contingent, against Customer. Customer shall present such claim or liability to Carrier or Carrier shall have thirty (30) days to resolve such claim. If the liability is not resolved, Customer shall have the right, after said thirty (30) days, to withhold any payment otherwise due the Carrier, or any person claiming by, through or under the Carrier, until Carrier furnishes satisfactory proof that such claim against or liability of Customer is discharged.

8. Not to assign this contract or any interest therein without the written consent of Customer first having been procured.

CUSTOMER AGREES:

9. To pay Carrier at the rates set forth in said Exhibit "A" hereto, on a weekly basis, by each Friday, for the products delivered and accepted by Customer during the preceding week.

IT IS MUTUALLY UNDERSTOOD AND AGREED:

10. This contract is not severable, time is of the essence and the essence of its performance. It is recognized, however, that there may be delays caused by bad weather, fires, strikes, acts of God, or circumstances beyond

the reasonable control of the parties hereto. Delays occasioned by such causes shall not constitute a default of this Agreement.

11. If, for any reason the Carrier cannot perform to the satisfaction of Customer or any Customer supplier customarily serviced by said Carrier, Customer reserves the right to dispatch other carriers into the plants of said suppliers to allow timely and satisfactory transportation of any and all products destined for Customer facilities. In no way should this paragraph be construed to indicate that the Carrier shall have exclusive rights to transport Customer material from any specific site and it is only for the convenience of both parties that customary sites will be assigned to the Carrier.

12. In the event either party shall fail to perform this contract or any part hereof, and in the manner specified, the other party may at its option give fifteen (15) days written notice to the other of its intention to terminate this contract. If the breach complained of in said notice is not corrected within said 15-day period, the contract shall terminate at the end of said period. Such termination shall not relieve the defaulting party from payment of damages occasioned to the other by said breach.

13. The parties hereto stand in the relationship to each other of independent contractors, and the Carrier is contracting independently with Customer, and the parties in no way stand in the relationship of master and servant, principal and agent, employer and employee, and it is further agreed that the Carrier is engaged in an independent business known as a motor carrier, and under the terms of this contract, said Carrier is free from any direction or control by Customer over the performance of the services required under this contract.

14. This Agreement shall terminate automatically:

> Immediately upon insolvency, adjudication of bankruptcy, or appointment of receiver for the property of the Carrier, and

15. Any such failure to exercise a right to terminate this Agreement in case of such default shall not constitute a waiver of the defaulting party's obligation to perform strictly in accordance with the terms of this Agreement. Any such right to terminate shall remain in full force and effect, and may be exercised so long as such default continues.

16. The term of this Agreement shall be for a period of five (5) years from date of execution hereof, and may be extended annually thereafter. During said term, the parties

will, before each anniversary date hereof, undertake to negotiate any increase or decrease in rates to be charged and paid, and in the event no agreement can be reached for the imposition of a new rate during the ensuing year, the rate prevailing at the anniversary date shall continue, but either party may thereafter cancel this Agreement upon giving one hundred and twenty (120) days written notice to the other of intent to cancel at the expiration of said 120 days. In the event any major or unforeseen cost, increase or decrease, should occur between anniversary dates, the parties agree to discuss the effect of such cost increase or decrease upon the rate, and may, upon mutual agreement, adjust such rates between anniversary dates.

17. This Agreement cannot be altered, modified or deviated from, unless such alteration, modification or deviation shall be in writing and signed by the parties hereto.

18. Any notice to be given hereunder may be served personally or by registered mail addressed to the party to be served at the latter's post office address as set forth in Exhibit "A" hereto.

19. In the event it should become necessary for either party to institute any action or proceeding under the terms hereof, it is agreed that the losing party in such action will pay to the winning party a reasonable sum for attorney's fees, together with its costs incurred therein.

20. This Agreement shall not become effective unitl:

- (a) It is fully executed by authorized agents of both parties, and
- (b) Carrier has secured all licenses and permits necessary for the full performance hereof.

21. This contract shall extend to and be binding upon, and insure to the benefit of the carrier and customer, their successors and assigns.

IN WITNESS WHEREOF the parties have caused this instrument to be executed by their duly authorized officers the day and year hereinabove first written.

Attest:

______________________________ By________________________

By________________________

Attest: RAYSON BROTHERS LOGGING CO., INC.

______________________________ By________________________

SAMPLE TIMBER SALE AGREEMENT

The Sample Timber Sale Agreement on the following pages is provided as a guide to forest landowners who are considering selling timber. It is a SAMPLE, only, and should not be used verbatim. Most of the agreement is self-explanatory. On some points, especially where several options are possible, a brief explanation or definition is included. You may wish to include other specific items. Particular attention should be given to Item D-12 pertaining to slash hazard reduction. The State Hazard Reduction or Management Law does not require 100 percent disposal of the slash fire hazard created. The bond withheld establishes a dollar amount available for hazard reduction performed in accordance to the written prescription in the Hazard Reduction Agreement. As the seller, you have the right to require more complete slash disposal in your contract. Keep in mind, however, that this will probably result in lower bid prices for your timber due to the increased hazard reduction costs.

It is strongly suggested that a professional forester, familiar with logging and the local timber market, be contacted. He can advise you or prepare a final agreement based on the specifics of your proposed timber sale. You may also require the services of an attorney.

The Division of Forestry maintains a listing of forestry consultants working in Montana. They are available to help prepare, sell, and administer timber sales. A copy of the consultant listing is available at Division of Forestry offices.

SAMPLE TIMBER SALE AGREEMENT

________________________________ of ________________, ______,
(I or we) (Name of Contractor) (Post Office) (State)

Hereinafter called the Contractor, agree to purchase from

______________________, of ______________, ________________
(Seller's Name) (Post Office) (State)

hereinafter called the Seller, the designated timber from the area described below and as outlined on Exhibit "A".

A. DESCRIPTION OF SALE AREA (Describe by legal subdivision, if surveyed, and approximate, if not)

TABLE I

				MINIMUM UTILIZATION STANDARDS	
SPECIES	PRODUCTS	ESTIMATED VOLUME	RATE PER	TOP DIAMETER INSIDE BARK	LOG LENGTH

B. TREES DESIGNATED FOR HARVEST: (Use one or more of the following:)

1. All trees greater than _____inches (diameter breast height) within cutting units shall be harvested. (Diameter limit cut)

2. Trees designated for cutting are marked with two horizontal ______ color paint lines, one at the base of the tree, the other at four and one-half feet (4 1/2') above the uphill ground line. (Selective Harvest)

3. All trees meeting merchantability clauses under Table I shall be harvested except "leave" trees marked with vertical ______(color) paint stripes. (Selective harvest with "leave" trees marked)

4. All trees shall be harvested from right-of-way clearings as designated by road-back lines on either side of the right-of-way.

5. Standing dead trees that fall within merchantability standards in Table I may be harvested.

C. CONDITIONS OF SALE:

1. METHOD OF PAYMENT: Payment shall be in accordance with the rates shown in Table I paid on a bi-weekly basis and subject to paragraphs two and three below. (NOTE: The Seller can also designate how payment from the purchasing wood products firm is to be distributed. Payments can be made to the Seller who then withholds his stumpage payment and forwards the balance to the logging contractor. This method serves as a type of "revolving" cash performance bond which is an incentive for the logging contractor to adhere to the contract. Advance stumpage payments should also be considered.)

2. ESCALATION:

   a) The rates stated in Table I reflect the negotiated price offered by the contractor. These rates are subject to escalation each six-month period of the agreement beginning _______________. Stumpage rates for each subsequent six-month period will be determined by obtaining the percentage relationships of the bid price of each species to the six-month average lumber price for that species as reported by the Western Wood Products Association Price Trends for the period ending ____________.

Other relevant price trends may be substituted upon mutual agreement.

3. BASIS OF MEASUREMENT:

   a) Sawlogs shall be scaled by the Scribner Decimal C log rule, or as otherwise agreed upon.

4. Ownership of the timber passes from the seller to the Contractor __________________. Use one of the following statements.

   a) At signing of contract - usually for lump-sum sales

   b) When severed from stump

   c) When loaded on truck

   d) When scaled at the processing plant

D. THE PURCHASER AGREES TO THE FOLLOWING:

1. To waive all claims to the above described timber unless they are cut and removed on or before
   _________________________.
   (Termination Date)

2. To commence logging on or after __________. (Note: Depending on the time of possession by the Seller, he may want to delay logging to qualify for capital gains treatment of timber income. The annual volume removed or dollars paid may also be set to avoid paying higher income taxes.)

3. To log only during the period ____________________,
   (Dates)
   unless special arrangements are made with Seller to log other than above-mentioned inclusive months.

4. Comply with all State Forest Fire Regulations.

5. To do all in his power to prevent and suppress forest fires on or threatening the sale area. Contractor shall be responsible for all fires which occur as a result of his activities.

6. To protect from unnecessary injury, young growth and other trees not designated for cutting.

7. At his expense, shall repair damage caused by logging to ditches, fences, bridges, trails or other improvements. Throughout the duration and upon termination of this Agreement existing roads will be maintained at standards equal to or better than original.

8. Enter into a road-use agreement with ______________
   (Agency or
   _____________________ for portion(s) of sale road
   Landlord)
   that crosses __________________________ ownership.
   (Agency or Landlord)

9. Liability for Loss:

   a) The Contractor is responsible for loss or damage to timber while in his custody. This includes timber which is felled, skidded, or decked, and timber which is lost or damaged after removal from the sale area, but before scaling.

10. Penalties:

a) The Contractor will furnish truck load receipt books and will be required to deliver a copy of the receipt with each load of forest products from the timber sale area to the Seller. The Contractor will be charged for each truck load receipt missing at the rate of eight (8) thousand board feet* at the current contract rate on the ratio of each species to the total estimated volume of the sale.

b) Unmarked or undesignated trees, seed trees or boundary trees which are cut or injured through carelessness shall be considered cut in trespass and charged for at the rate of $_______ each.

c) Trees which are designated for cutting under terms of this Agreement and/or logs which meet the minimum utilization standards set forth in Table I which are not removed from the sale area and presented for scaling shall be charged at the current contract rate for the class of material which they contain, fixed in accordance with the terms of this Agreement.

d) The Contractor may be required to pay a penalty of $_______ each for cutting long butts which in the opinion of the Seller contains usable material in excess of the minimum utilization standards set forth in Table I.

e) The Contractor may be required to pay a penalty of $_______ for each tree stump cut higher than ________ on the side adjacent to the highest ground except in unusual cases, when in the discretion of the Seller, this height is not considered practical.

f) The amounts specified shall be regarded as liquidated damages and may be waived in the discretion of the Seller in accidental or exceptional cases which involve small amounts of material or minor deviation from the conditions, standards or specifications.

11. Handle slash and logging debris as prescribed by Montana State Law.

12. Provide additional slash money in the amount of $________/green trees to cover slash cleanup and treatment beyond specifications required by State Law.

*Based on long-log hauling capacity.

13. The Contractor will be required to furnish a cash or surety bond in an amount of $________ for faithful performance of the Agreement.

14. Refuse resulting from the Contractor's use, servicing, repair, or abandonment of his equipment shall be removed from the area.

15. Equipment will not be operated in seep areas, springs, or stream courses. Any operation or construction in or near perennial streams may require a Stream Bed Preservation Permit prior to construction. Contractor shall comply with this law and any other natural resource laws, if applicable. (Seller may also wish to add, as an attachment, the Best Management Practices for non-point sources pollution under the state-wide 208 Program)

16. The Contractor will be required to install rolls, cross-ditches or outslope road beds, fire lanes, and skid trails to prevent soil erosion.

17. Contractor or his employees or agents may not remove fuelwood or firewood without explicit consent of the Seller.

18. Other restrictions as desired.

19. Method of logging to be used--i.e. tree length, log length, line skidded, etc.

E. THE SELLER AGREES TO THE FOLLOWING:

1. To guarantee title to the forest products covered by this Agreement and to defend it against all claims at his expense.

2. To allow the Contractor to use unmerchantable material from tops of trees cut from trees for necessary logging improvements free of charge, provided such improvements are left in place by the contractor.

3. To grant freedom of entry and right-of-way to Contractor and his employees on and across the area covered by this Agreement.

F. The contractor is responsible for all injuries or accidents occurring as a result of logging and related activities. Note--Seller may require contractor to provide proof of compliance with workman's compensation laws.

G. This Agreement cannot be transferred or subcontracted to another party without the written permission of the Seller.

H. Cutting of timber under this Agreement expires on ____ , (Date) unless otherwise agreed to in writing by the Seller. Felled trees remaining after the above date become the property of the Seller ninety (90) days following that date.

I. In cases of dispute over terms of this Agreement, we agree to accept the decision of an arbitration board of three selected members as final. Each of the contracting parties will select one person and the two selected will select the third person to form this board.

J. Violations of this Agreement by either party will be considered cause for termination.

Signed this ______of__________, 19___.

____
(Seller)

____
(Contractor)

Witness:____________________________

Witness:____________________________

(This Agreement is to be used as a SAMPLE copy only. Obtain services from your State Service Forester, consultant forester and/or attorney.)

SAMPLE TIMBER SALE AGREEMENT

The Sample Timber Sale Agreement on the following pages is provided as a guide to forest landowners who are considering selling timber. It is a SAMPLE, only, and should not be used verbatim. Most of the agreement is self-explanatory. On some points, especially where several options are possible, a brief explanation or definition is included. You may wish to include other specific items. Particular attention should be given to Item D-12 pertaining to slash hazard reduction. The State Hazard Reduction or Management Law does not require 100 percent disposal of the slash fire hazard created. The bond withheld establishes a dollar amount available for hazard reduction performed in accordance to the written prescription in the Hazard Reduction Agreement. As the seller, you have the right to require more complete slash disposal in your contract. Keep in mind, however, that this will probably result in lower bid prices for your timber due to the increased hazard reduction costs.

It is strongly suggested that a professional forester, familiar with logging and the local timber market, be contacted. He can advise you or prepare a final agreement based on the specifics of your proposed timber sale. You may also require the services of an attorney.

The Division of Forestry maintains a listing of forestry consultants working in Montana. They are available to help prepare, sell, and administer timber sales. A copy of the consultant listing is available at Division of Forestry offices.

205: Prepare all required construction and operating permit applications. Conduct initial planning meetings with all appropriate governmental agencies to evaluate probability of securing permits when required. Prepare a master time schedule with major milestones depicting the time required to secure each permit. Identify all information requirements to secure each specific permit.

Product: Prepared applications and a licensing schedule.

A. TASK REPORT TABLE OF CONTENTS

1. Introduction
2. Purpose and Task Description
3. System Descriptions for Energy Source Options
4. Prepare construction and operating permit applications
5. Conduct initial meetings with appropriate governmental agencies
6. Prepare a master time schedule with major milestones and time to secure each permit
7. Identify all information requirements for each permit

B. LIST OF REFERENCES

(List key personnel, phone numbers etc for each permit.)

TASK NO. 205 - ENVIRONMENTAL PERMIT REQUIREMENTS

Before constructing a 6 Mw electric/steam generating plant adjacent to the Kootenai River, a number of environmental permits will be required including:

1. Corps of Engineers - required only if any dredge, fill activity, or other works affect the river or wetlands. Of particular concern is erosion of the river bank as a result of construction.

2. Ash Disposal - Ash from the plant would be disposed of on W. R. Grace property along with the mine tailings. Woodwaste ash and coal ash contain no hazardous substances. W. R. Grace is already permitted to dispose of mine wastes. Ash from the plant would be insignificant compared to the tons of waste disposed of by the mine. It is unlikely that a special permit will be required, however, the process and timetable are included in the permit timetable following this section.

3. Wastewater Disposal-(Process wastewater) Discharge permit required from the Department of Health and Environmental Sciences, Water Quality Bureau.

4. Domestic Wastewater Disposal - On-site sewage disposal permit required from Lincoln County.

5. Flood Plain Permit - Required from Lincoln County if the area of the site is within the flood plain boundaries (approximately 200 feet from shoreline).

6. Building Permit - A permit is required prior to any construction from Montana State Building Codes Division.

7. Air Quality Permit - The EPA - PSD permit and the Montana State permit are both handled through Montana State. One application form is required. The air quality in the Libby area is somewhat sensitive, but depending on the amount of fuel burned, licensing should be possible without major problems. If woodwaste is burned, the emissions are low enough that the plant does not qualify as a major stationary source and is not subject to PSD permitting. Montana State officials could not anticipate any problems in procuring a state permit for wood. If coal is used as fuel, the coal may affect the permit process and the cost of pollution equipment.

Permitting Timetable

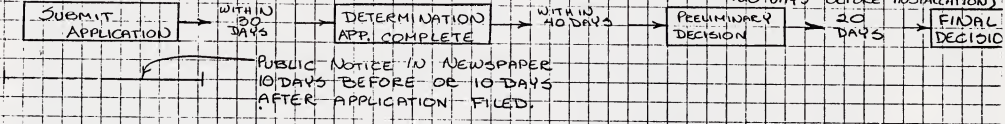
The Montana Air Quality permit will take the longest to procure, with a six-month lead time. The timetable on the following page shows each permit and the process and time involved.

Applications and Permits Regulations

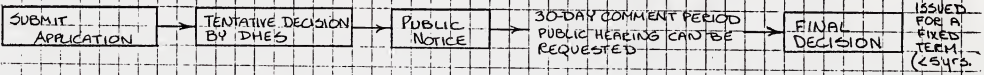
The regulations and applications forms for each permit are included in this section following the Permit Timetable.

For the small coal or woodwaste burner which would be located at the mountain top, permitting should be fairly simple. The mine's existing water supply and wastewater systems can be utilized and the small amount of ash can be mixed with mine tailing. The only permits that may be required would be a building permit and an air quality permit. The quantity of fuel burned is low, and the emissions should not be substantial for either coal or wood. Permitting should still be done six months ahead of construction, but no problems are foreseen.

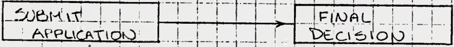
o MONTANA STATE AIR POLLUTION PERMIT - BEGIN PROCESS AT LEAST 6 MONTHS BEFORE CONST.
(180 DAYS BEFORE CONST. OR 120 DAYS BEFORE INSTALLATION)


SUBMIT APPLICATION
WITHIN 30 DAYS
DETERMINATION APP. COMPLETE
WITHIN 40 DAYS
PRELIMINARY DECISION
20 DAYS
FINAL DECISIO
PUBLIC NOTICE IN NEWSPAPER 10 DAYS BEFORE OR 10 DAYS AFTER APPLICATION FILED.

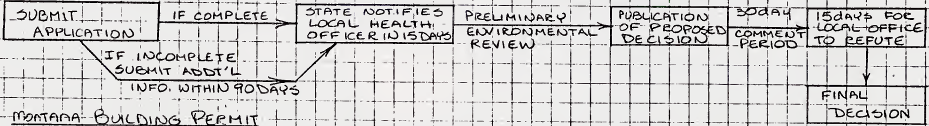
o WASTEWATER DISCHARGE PERMIT - PLANT WATER TO RIVER - MONTANA DHES


SUBMIT APPLICATION
TENTATIVE DECISION BY DHES
PUBLIC NOTICE
30-DAY COMMENT PERIOD PUBLIC HEARING CAN BE REQUESTED
FINAL DECISION
ISSUED FOR A FIXED TERM. (<5yrs.

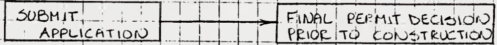
o DOMESTIC WASTEWATER - DRAINFIELD (MUST BE CONSTRUCTED WITHIN 6 MONTHS OF PERMIT APPROVAL) - LINCOLN COUNTY



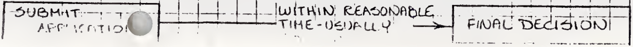
o SOLID WASTE DISPOSAL PERMIT - ASH DISPOSAL - MONTANA DHES


SUBMIT APPLICATION
IF COMPLETE
IF INCOMPLETE SUBMIT ADDT'L INFO. WITHIN 90 DAYS
STATE NOTIFIES LOCAL HEALTH OFFICER IN 15 DAYS
PRELIMINARY ENVIRONMENTAL REVIEW
PUBLICATION OF PROPOSED DECISION
30 day COMMENT PERIOD
15 days FOR LOCAL OFFICE TO REFUTE
FINAL DECISION

o MONTANA BUILDING PERMIT



o LINCOLN COUNTY FLOODPLAIN DEVELOPMENT PERMIT



4. Radioactive Material. Describe the use and processing of radioactive material.

If authority to construct is granted, deviations from the approved plan are not permissible without prior approval from the Air Quality Bureau.

Additional information may be required, and certain requirements may be waived.

Further information or clarification concerning applications can be obtained by calling or writing the Montana State Department of Health and Environmental Sciences, Air Quality Bureau, Helena, Montana 59620. Phone: 406-449-3454.

AIR QUALITY PERMIT APPLICATION INSTRUCTIONS

Complete all items on application form. In addition, the following information must be supplied:

1. Equipment Location Drawing. A drawing or sketch must be submitted to scale (suggest 1" = 100', measurement to nearest 5') showing at least the following:

   a) The property involved, and outline and height of all buildings on it. Identify property lines plainly.

   b) The location and identification of the proposed equipment on the property

   c) The location of the property with respect to streets and all adjacent properties. Identify adjacent property and buildings on it. Indicate North.

2. Equipment Description. State make, model, size and type for the entire unit and/or its major parts. Include such drawings as are necessary to show clearly the design and operation of the equipment and the means by which air contaminants are controlled. Included should be sizes, shapes and dimensions of the equipment and information which may affect the production, collection, conveyance or control of air contaminants. Include full details for dual burners. Give type of fuel and quantity burned, BTU rating and percent sulfur. Manufacturer's catalogs may be used if they provide sufficient information.

3. Description of Process. The application must be accompanied by a written description of all processes affected by the equipment. Supply all data regarding the process. Note all points or possible points of emissions, and types and quantities of contaminants emitted. If available, state volumes, particle sizes, concentration and nature of air contaminants. Describe control methods and efficiencies. Give the operating schedule (hrs/day, days/week). Detail type and total of materials being processed on the basis of pounds/hour or other unit of time on a process flow diagram. Estimate the amount of downtime.

Permit No.__________

AIR QUALITY PERMIT APPLICATION FOR SOURCES OF AIR POLLUTION

Montana State Department of Health and Environmental Sciences
Air Quality Bureau
Helena, Montana 59601 Phone: 406-449-3454

Applications are incomplete unless accompanied by copies of all plans specifications and drawings required. Details required for specific equipment are available on request. This application must be signed by a responsible member of the organization that is to operate the equipment for which application is made.

INCOMPLETE APPLICATIONS ARE NOT ACCEPTABLE.

1. Permit to be issued to (business license name of organization that is to operate the equipment):

Name Rayson Bros. Logging Company

☐ Corporation ☒ Partnership ☐ Individual ☐ Government

Address P.O. Box 995
Libby, MT Zip Code 59923

2. Address at which equipment is to be located: P.O. Box 995 Libby MT 59923
Legal description: S32 T31N R30W

3. General Nature of Business: woodwaste fueled [illegible] MW steam/electric generating project

4. General Equipment Description: See attached project description

5. Estimated Cost of Equipment of Alterations:

Basic Equipment $________ Air Pollution Control Equipment $150,000

6. Present Status of Equipment: Check and Complete Applicable Items.

	Estimated Starting Date	Estimated Completion Date
☒ New Installation		
☐ Alteration to Existing Installation		
☐ Transfer of owner, operator or lessee		
☐ Transfer of location		

(continued)

7. If this equipment had a previous permit, give:

Name ________ Most Recent Permit Number ________

8. Name, title and signature of responsible member of firm:

Name (Print or Type) DAVID G. VAN HEDSETT, P.E.

Title PROJECT MANAGER

Phone Number 509-838-8024

Signature ________ Date ________

Person to contact regarding this application:

Name JERRIE LITTLE Phone 509-838-8024

INSTRUCTIONS TO APPLICANTS

The notice below must be published no earlier than 10 days prior to the date your application will be submitted to the Department, and no later than 10 days following the date of submittal. The notice is to be published in the legal notice section of a newspaper of general circulation in the area affected. Questions regarding an appropriate newspaper should be addressed to the Bureau. Please submit a copy of the published notice to the Bureau with the application, if possible, or as soon thereafter as possible.

This notice is required by ARM Title 16, Chapter 8, Sub-chapter 11, SRM 16.8.1107.

PUBLIC NOTICE

Notice of Application for Air Quality Permit (Pursuant to Section 75-2-211 MCA, and ARM Title 16, Chapter 8, Sub-chapter 11, PERMIT, CONSTRUCTION AND OPERATION OF AIR CONTAMINANT SOURCES),

____
(Name of Applicant (has filed/will file)

on or about __________________ for an application for an Air
(date)
Quality Permit from the Air Quality Bureau ("Bureau") of the Environmental Sciences Division, Montana Department of Health and Environmental Sciences. Applicant seeks approval of its application for ______________________________
(brief description of construction, modifica-

____
tion or project for which permit is being applied for,

____.
including location, section, township, & range)

The Bureau must determine whether or not the application is complete. Within 30 days of receipt of the application, the Bureau will make a preliminary determination whether the permit should be issued, issued with conditions or denied. Any member of the public who wishes to receive notice of the Bureau's preliminary determination, and the location where a copy of the application and the Bureau's analysis of it can be reviewed, or to submit comments on the preliminary determination, must contact the Bureau at the Cogswell Building, Helena, Montana 59620 (Phone: (406) 444-3454).

Any comments on the preliminary determination by persons requesting and receiving the above notification must be submitted to the Bureau within 15 days after the notification is mailed. The notification will also contain the date when the final decision on the application will be made by the Bureau, the name of the person from whom a copy of the final decision may be obtained, and the procedure for requesting a hearing of the decision before the Board of Health and Environmental Sciences.

WOOD-FIRED STEAM/ELECTRIC GENERATION PLANT
LIBBY, MONTANA
PROJECT DESCRIPTION

Rayson Bros. Logging Company proposes to construct a 6mw electric generating station on a site owned by W.R. Grace & Company, near the Kootenai River about five miles east of Libby, Montana. The plant's electric generation will be sold to an electric utility. Also, hot gas will be produced and used by the adjacent vermiculite drying operations.

SITE

The five (5)-acre site is located along the Kootenai River, southwest of U.S. Highway 93, five miles east of Libby, Montana in Lincoln County (see Figures 1 and 2). The legal description is S32, T31N, R30W. The site is currently vacant and is owned by W. R. Grace and Company. The site will be leased from the property owner. A Pacific Power & Light Company substation is located at the north end of the site.

The site election is 2,100 feet above sea level with the river elevation at about 2,040 feet above sea level.

PLANT DESCRIPTION

Plant Operation

The plant is designed to operate 24 hours per day, five days per week year round with the exception of periods of forced outage and annual maintenance. The plant is scheduled to operate 6,240 hours per year, or 71 percent plant factor.

Schedule

Construction of the plant is scheduled to begin in 1985. Site preparation will take approximately one to two months. Construction, equipment installation, and start-up procedures will take an additional 12 months. The plant life is estimated at 35 years.

Plant Equipment

The six megawatt plant, once in operation, will burn 60,460 tons of woodwaste per year. For start-up purposes only, No. 2 oil will be burned. The fuel will be burned in a conventional traveling grate boiler. Steam will be generated at 600 psig and 750 degrees F. This temperature and pressure is typical for power boilers in this size range (77,000 lbs/hour). Approximately eight to nine tons per hour of fuel will be burned. Based on the preliminary design, the total design volume from the stack will be 226,500 lbs/hr at 140^{o} F. Cooling water to remove heat from the condenser will come from a mechanical draft cooling tower. The turbine generator will generate power which will be raised by a step-up transformer to 13,800 volts.

Ash will be collected from the boiler and stack gas clean-up system. Sand-like, non-hazardous ash will be disposed of in the W. R. Grace vermiculite mine tailing areas. This ash, 240 tons per year, will be insignificant compared to the waste disposed of by the vermiculite mine. The W. R. Grace mine processes 3,400,000 tons of ore and waste per year. Over 93 percent is waste and is accumulated in the mine tailings area.

Fuel Supply

The plant will require 95,000 tons per year of wood fuel. Number 2 oil will be used for start-up fuel for the boiler.

An on-site, three-acre, 20-foot-high fuel pile and a log deck will contain both millwaste and forest residue to supply up to three months' fuel. In addition to forest residue, fuel will be supplied by sawmills located in a 100-mile haul distance.

Refer to tASK 201, "Fuel Supplier Map" for the location of sawmills within 100 miles of the plant site.

The millwaste will be delivered by truck, hogged to a consistent and uniform size, stored in a paved, "first-in, first-out" fuel pile. Forest residue will either be directly hogged upon delivery or stored on the log deck and hogged at a later date.

With proper maintenance, the hogged fuel pile will not emit any odor.

Water Supply

Process water for the plant and domestic water will be taken from the existing W. R. Grace water supply system located at the W. R. Grace processing plant located adjacent to the northwest end of the plant site.

Wastewater Disposal

Domestic wastewater will be disposed of in an on-site septic tank and drainfield which will be installed in accordance with county regulations. The plant will have an operating staff of about three people.

Oily wastes will be segregated and disposed of off-site.

Process wastewater will be cooled in a mechanical draft cooling tower, tested for quality, and discharged into the Kootenai River. During the process, wastewater does not come into contact with the fuel or other pollutants. It is treated for use in the boiler and, if necessary, will again be treated prior to disposal.

Plant Aesthetics

During the design and construction of the plant, focus will be given to the visual impact of the finished plant. Appropriate colors and materials will be chosen and where possible, vegetation and topography will be left in their natural state.

List of References

- Air Quality Rules, Montana Department of Health and Environmental Sciences, Environmental Sciences Division, State of Montana, July, 1984.
- Glen P. Green, District Conservationist, Soil Conservation Service, State of Montana.
- Jack W. Rogers, State Soil Scientist, Federal Building, Boseman, Montana. (406-587-5271)
- Jim Whipple, USGS Geologist, (509-456-4677
- Fish & Wildlife Game Agents, Gary Beenke and Harold Burnel, State of Montana, Libby, Montana.
- Montana Historical Society, 225 North Roberts, Helena, Montana 59620 (406-444-2694)
- Site Form's: Dr. Dee Taylor, Antropology, University of Montana, Missoula, Montana.
- Jerry Brown, Wildlife Biologist, State of Montana,(406-293-7905)
- Joe Houston, Fish Biologist.
- Jim Vashrow, Fish Agent, (406-755-5505) Kalispell, Montana.

FLOODPLAIN DEVELOPMENT PERMIT

Name of Applicant Rawson Bros. Logging Company Date 11/14/84

Address Rt. 3, Box 995, Libby, Montana 59923 Telephone (406) 293-930

Location of Proposed Development S32, & T31N, ~~[illegible]~~ R30W - see site map attached

Description of Development

☐ Residential Construction

☐ New Construction

☐ Addition or Improvements

☐ Non-Residential

☒ New Construction

☐ Addition or Improvements

☐ Mobile HOme

☐ On Single Lot

☐ In Mobile Home Park

☐ Subdivision

☐ New Subdivision

☐ Addition

☐ Fill

☐ Watercourse Alteration

☒ Other (6 MW) Coal or Wood-fired electric generating plant - see attached project description

Attach to the application the following information where applicable. Plans in duplicate, drawn to scale showing the nature, dimensions, and elevations of the area in question; existing or proposed structures, fill, storage of materials, drainage facilities; and the location of the foregoing. Specifically, the following information is required: (1) Mean Sea Level (MSL) elevation of the lowest floor (including basement) of all structures; (2) MSL elevation to which any structure is floodproofed; (3) certification by a registered professional engineer or architect that the floodproofing methods meet the community floodproofing criteria; and (4) a description of the extent to which any watercourse will be altered or relocated.

The following is to be completed by the Development Permit Official:

The proposed development is located in the ☐ Floodway ☐ Floodfringe

The Base Flood Elevation or depth number at the development site is: __________

Source Documents: __________

Plan Review

MSL Elevation or depth number to which the structure is to be elevated: __________ ft. NGVD

MSL Elevation or depth number to which the structure is to be floodproofed: __________ ft. NGVD

All necessary information and certificates are attached.

Action

☐ The proposed development is not in conformance with applicable Floodplain Management Requirement (explanation attached). Permit is denied.

☐ I have reviewed the plans and materials submitted in support of the proposed development and find them in compliance with applicable Floodplain Management Requirements. Permit is approved.

__________ Date __________ (Signature)

Building Construction Documentation

The certified as-built elevation of the lowest floor of the structure is __________ feet NGVD

The certified as-built floodproofed elevation of the structure is __________ feet NGVD

Certificates of a registered professional engineer or land surveyor documenting these elevations are attached.

Certificate of Occupancy Issued: __________ __________ (Signature) efer to the FLOOD INSURANCE RATE MAP EFFECTIVE date hown on this map to determine when actuarial rates apply to tructures in the zones where elevations or depths have been established.

o determine if flood insurance is available in this community, ontact your insurance agent, or call the National Flood Insurance rogram, at (800) 638-6620, or (800) 424-8872.

APPROXIMATE SCALE

2000 0 2000 FEET

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

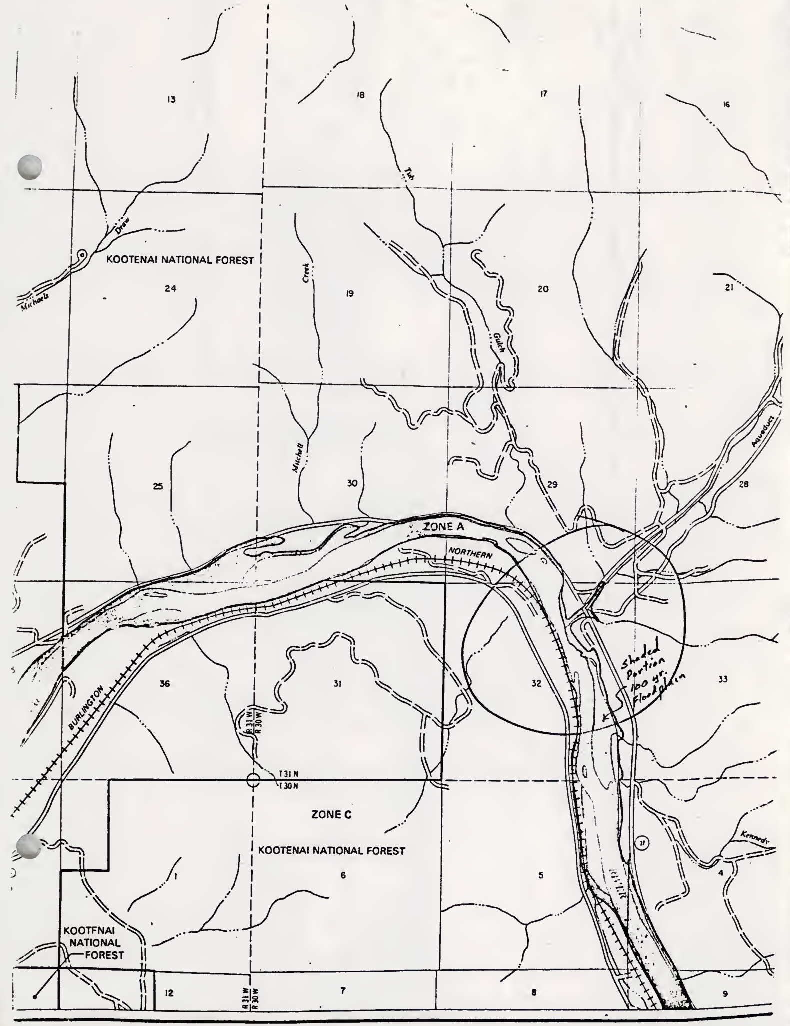
LINCOLN COUNTY,
MONTANA
(UNINCORPORATED AREAS)

PANEL 650 OF 1100
(SEE MAP INDEX FOR PANELS NOT PRINTED)

COMMUNITY-PANEL NUMBER
300157 0650 B

EFFECTIVE DATE:
AUGUST 1, 1980

U.S. DEPARTMENT OF HOUSING
AND URBAN DEVELOPMENT
FEDERAL INSURANCE ADMINISTRATION

13
18
17
16
Draw
Tus
KOOTENAI NATIONAL FOREST
Michaels
24
Creek
19
Gulch
20
21
Aqueduct
Mitchell
25
30
29
28
ZONE A
NORTHERN
BURLINGTON
36
31
32
33
Shaded Portion 100 yr. Floodplain
R31W
R30W
T31N
T30N
ZONE C
KOOTENAI NATIONAL FOREST
1
6
5
4
Kennedy
37
RIVER
KOOTENAI NATIONAL FOREST
12
R31W
R30W
7
8
9

efer to the FLOOD INSURANCE RATE MAP EFFECTIVE date hown on this map to determine when actuarial rates apply to tructures in the zones where elevations or depths have been established.

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NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

LINCOLN COUNTY, MONTANA
(UNINCORPORATED AREAS)

PANEL 650 OF 1100
(SEE MAP INDEX FOR PANELS NOT PRINTED)

COMMUNITY-PANEL NUMBER
300157 0650 B

EFFECTIVE DATE:
AUGUST 1, 1980

U.S. DEPARTMENT OF HOUSING
AND URBAN DEVELOPMENT
FEDERAL INSURANCE ADMINISTRATION

MONTANA POLLUTANT DISCHARGE ELIMINATION SYSTEM
APPLICATION FOR PERMIT TO DISCHARGE - SHORT FORM C

FOR AGENCY USE	APPLICATION NUMBER
	DATE RECEIVED
	YEAR / MO. / DAY

RETURN TO: Water Quality Bureau
Dept. of Health & Environmental Sciences
A-206 Cogswell Building
Helena MT 59620
Phone: (406) 444-2406

Please print or type.

1. Name, address, location, and telephone number of facility producing discharge:

   A. Name Rayson Brothers Logging Company

   B. Mailing address

      1. Street Address Route 3, Box 995
      2. City Libby
      3. County Lincoln
      4. State Montana
      5. Zip Code 59923
      6. Telephone number (406) 293-9306

   C. Location of discharging facility:

      1. Street or Section, Township, Range S 32, T31N, R30W
      2. City Approx. 5 mi. east of Libby
      3. County Lincoln
      4. State Montana
      5. Telephone number message (406) 293-9306

2. Number of Employees 3

3. Give a brief narrative description of your process or what your facility is: Coal-fired or Wood-fired electric generating plant which will produce 6 MW of electricity to be sold to an electric utility.

   The process wastewater will be discharged into the Kootenai River. A brief project description and process flowchart are attached. Note that the plant will utilize a dry ash handling system and that the discharge water quality will not be affected by the fuel burned. Domestic wastewater will be disposed of separately in a septic tank/drainfield.

4. Proposed handling of wastewater: (check one)

☐ Complete retention or recycle with no discharge

☐ Discharge to municipal sewage system (specify Municipality) ____________

☒ Direct discharge after treatment (specify type of treatment) One-day holding tank to cool water prior to discharge.

☐ Direct discharge with no treatment

5. What is the expected flow rate of your discharge: 64 GPM avg.- Summer 50 GPM avg.- Winter gallons per minute.

6. When do you expect to begin discharge: 12 (Month) 1 (Day) 85 (Year)

7. When do you expect to terminate discharge: 35-year plant life (Month Day Year)

8. (a) check here if discharge occurs all year ☒ , or note: above shows seasonal flows

(b) circle the month(s) discharge occurs:

January February March April May June July

August September October November December

(c) circle number of days per week: 1. 1 2. 2-3 3. 4-5 [✓ 4. 6-7]

9. Circle number of separate discharge points: [✓ A. 1] B. 2 C. 3 D. 4 or more

10. Name of receiving water or waters: Kootenai River

I certify that I am familiar with the information contained in the application and that to the best of my knowledge and belief such information is true, complete and accurate.

Printed Name of Person Signing ____________ Title ____________

Signature of Applicant ____________ Date Application Signed ____________

Subsection (6) of Section 69-4823 provides that any person who knowingly makes a false statement, representation, or certification on this application shall upon conviction be subject to a fine or not more than $10,000 or by imprisonment for not more than six (6) months or both.

SUPPLEMENTAL INFORMATION REQUESTED

SHORT FORM C

1. Location of all discharge points (locate each discharge point below by township, range, section, and 1/4 section). Attach topographic map if available.

2. Indicate the concentrations of the following substances in your wastewater and in the receiving water. Analyze only those checked.

		CONCENTRATION	
	SUBSTANCE	Wastewater	Receiving Water
☐	Ammonia (as N), mg/l	see attached	see attached
☐	Total Kjeldahl Nitrogen, mg/l	from Inland	Montana Environmental
☐	Nitrate-Nitrite (as N), mg/l	Aqua-Tech Co., Inc.	Laboratory Analyses
☐	Total Phosphorous (as P), mg/l		Kootenai River
☐	Orthophosphate (as P), mg/l		
☐	Biochemical Oxygen Demand (5-day BOD), mg/l		
☐	Chemical Oxygen Demand, mg/l		
☐	Total Suspended Solids, mg/l		
☐	Total Dissolved Solids, mg/l		
☐	Specific Conductance, umhos/cm at 25°C		
☐	pH, Units		
☐	Temperature, °F		
☐	Aluminum, mg/l		
☐	Arsenic, mg/l		
☐	Beryllium, mg/l		
☐	Boron, mg/l		

	SUBSTANCE	CONCENTRATION Wastewater	 Receiving Water
	Cadmium, mg/l		
	Chromium, mg/l		
	Copper, mg/l		
	Iron, mg/l		
	Lead, mg/l		
	Manganese, mg/l		
	Mercury, mg/l		
	Nickel, mg/l		
	Selenium, mg/l		
	Silver, mg/l		
	Zinc, mg/l		
	Cyanide, mg/l		
	Oil and Grease, mg/l		
	Phenols, mg/l		
	Total Chlorine Residual, mg/l		

3. What is the expected flow rate of your discharge? Average gpm 64 summer 50 winter Maximum gpm ____

4. What is the estimated low flow in the receiving water? Annual ____ 10-year ____

M.E. LAB

Montana Environmental Laboratory

376 W. Washington — P.O. Box 1876 Kalispell, Montana 59901 Phone: 755-2131

NEOMA RENEI SOL

Date Received: 9-2-83
Date Reported: 9-19-83
MEL # : 472 thru 480

Reported To: W.R.Grace & Co. - ATTN: R. Geiger
Sample Source: W.R.Grace & Co.
Sample Date: 9-1-83

SPECIAL WATER ANALYSIS:

Parameter	Kcci # 6	Romac Mill # 7	S.P. # 8	LOADING # 9	Limits
pH	8.0	7.1	7.3	7.4	---
Total Alkalinity as $CaCO_3$	93	342	254	207	---
Phenolphthalein Alkalinity	0	0	0	0	---
Calcium	8.0	20.0	33.7	44.9	---
Magnesium	27.6	73.9	45.[illegible]	30.7	---
Total Hardness as $CaCO_3$	133	353	271	235	0 - 4... Soft 5 - 12.. Med. over 12. Hard
as gpg	7.8	20.6	15.8	13.9	
Total Iron	0.04	<0.01	0.02	0.45*	0.3
Sulfate	15.5	11.0	1[illegible].9	18.0	250
Nitrate as N	0.05	0.17	0.20	3.7	10
Total Dissolved Solids	122	355	300	266	500
Potassium	<2	6.	4.7	1.2	---
Sodium	[illegible].3	11.5	13.[illegible]	9.2	---
Arsenic	<0.005	<0.005	<0.005	<0.005	0.05
Barium	0.1	0.5	0.3	0.2	1.0
Cadmium	<0.001	<0.001	0.002	<0.001	0.010
Chromium	<0.02	<0.02	<0.02	<0.02	0.05
Chloride	2	9	3	6	250
Fluoride	0.22	1.44	1.09	0.22	2.4
Lead	<0.01	<0.01	0.02	0.02	0.05
Manganese	<0.02	0.02	<0.02	<0.02	0.05
Mercury	<0.001	<0.001	<0.001	<0.001	0.002
Selenium	<0.005	<0.005	<0.005	<0.005	0.01
Silver	<0.005	<0.005	<0.005	<0.005	0.05
Zinc	<0.01	1.59	2.36	1.52	---

RS

NOTE: Water is suitable for drinking (except for problem (*) noted below)
(---) no established limits

* Total Iron #9 is over the limit of 0.3.........

M.E. LAB

Montana Environmental Laboratory

376 W. Washington - P.O. Box 1876 Kalispell, Montana 59901 Phone 755-2131

NEOMA (RENE) SOL

March 25, 1983

W.R. Grace & Co.
P.O. Box 609
Libby, Mt. 59923

Sample Date: 3-17-83

SPECIAL WATER ANALYSIS:

	RAINY [illegible] #1	TOE DRAIN #2	CARNEY #3	LOWER POND #4	RAINY & KOOT. #5	KOOT. R. #6
Total Suspended Solids (mg/l)................	1	1	120	6	26	12
Total Dissolved Solids (mg/l)................	234	431	327	358	341	238
Turbidity (NTU)................	.5	.5	80	2.4	10	5.8
Sulfate (mg/SO_4/l)............	5	12	21	13	15	1[illegible]
Specific Conductance (micromhos/cm)........	350	690	400	565	520	370
pH......................	8.1	7.7	8.4	8.4	8.5	8.1
Total Phosphorus (mgP/l)..............	<0.01	0.43	0.47	0.31	0.34	0.15
Nitrate (NO_3-Nmg/l)...........	<0.01	<0.01	0.32	<0.01	<0.01	<0.01
Kjeldahl Nitrogen (mg/l)................	<0.3	<0.3	0.5	<0.3	<0.3	0.3
Ammonia (NH_3-Nmg/l)...........	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Fluoride (mg/l)................	0.10	4.7	<0.01	4.5	1.63	1.58

B. List of References for Environmental Information

- Soil Conservation Service
  Jack Rogers, State Soil Scientist
  Federal Building, Room 443
  10 East Babcock
  Bozeman, MT 59715
  Phone: (406) 587-5271

  Larry Greene - Soil Expert
  Eureka Office
  Phone: (406) 296-2233

- Montana Fish, Game & Parks
  Jerry Brown - Wildlife Biologist
  Libby, MT
  Phone: (406) 293-7905

  Brad Shepherd - Fish Biologist
  Phone: (406) 293-7639

  Gary Burke, Game Agent
  Libby, MT
  Phone: (406) 293-7414

- Regional Fish Biologist
  Joe Houston
  Regional Fish Agent
  Jim Vashrow
  Kalispell, MT
  Phone: (406) 755-5505

- U. S. Geological Survey
  Jim Whipple, Spokane, WA
  Geologists with experience in Montana geology
  Phone: 456-4677

- Montana Historical Society
  225 North Roberts
  Helena, MT 59620
  Phone: (406) 444-2694
  Marcella Sherfy

- Department of Highways
  Phone: (406) 444-2482

- Dr. Dee Taylor
  Anthropology
  University of Montana
  Missoula, MT

B. List of References for Permit Information

- Lincoln County Planning

  Floodplains Permit

  Ken Petersen
  Libby, MT
  Phone: (406) 293-7781

- Department of Health & Environmental Science

  Water Discharge - Kootenai River

  Dick Petersen
  Phone: (406) 444-2406

- Department of Health & Environmental Science

  Air Quality Permit

  Warren Nordan
  Libby, MT
  Phone: (406) 444-3454

- Department of Administration

  Building Permit

  Building Codes Division
  Phone: (406) 444-3933

Subject: Blending Coal & Wood for fuel

Chuck Keegan, U. of MT. Department of Economic Research referred us to this man as an expert in this area.

Tom Miles, Sr.
Consulting Design Engineers
5475 S.W. Arrowwood Lane
Portland, Oregon 97275
Phone: (503) 292-2919

Re: Ron Varger, U. S. Forestry Lab.

TASK NO: 206: IDENTIFY FINANCING ALTERNATIVES

TASK MANAGEMENT INFORMATION

LIBBY BIOENERGY PROJECT

ACTIVITY SCHEDULE

Task Start Date: October 22, 1984
Task Completion Date: December 10, 1984

PERSONNEL WORKING ON TASK

Name	Company	Phone No.
Task Leader Steve Schaub	J. S. Schaub & Co., Inc	509/838-8978
Clayton Rayson	Rayson Bros.Logging	406/293-9306
Sam Van Arsdale	Rayson Bros	509-926-7818
Tom Peck	CPA	406-293-3729
Mike Ray	W. R. Grace	406-293-3746

Prime Contractor Clayton Rayson	Rayson Bros Logging	406-293-9306
Project Manager Dave Van Hersett	Resource Dev. Assoc	509-838-8024

TASK REPORT TABLE OF CONTENTS

1. Introduction
2. Purpose and Task Description
3. System Descriptions for Energy Source Options
4. Capital Cost Summary for Energy Source Options
5. Identify Likely Financing Methods for Project Debt and Equity By Third Parties
6. Prepare a Base Case Financing Approach for Rayson Brothers, Third Party and W. R. Grace & Co. to use in Developing Capital Cost Projections for Their Respective Subsystems
7. Prepare a Financial Model (15-year) to Evaluate the Financial Performance of each Energy Subsystem
8. Identify Potential Lending and Financing Institutions in Support of Proposed Financing Methods
9. Make Preliminary Contact with Potential Financing Sources and Document their Interest in Participating in This Project Financing
10. Prepare a Summary of Expected Cost of Financing by Energy Subsystem by Financing Party
11. References:

1.0 Introduction:

Financing of capital expenditures for the energy options will be assumed to be as follows:

Bioenergy Option: Forest/sawmill residue recovery and fuel preparation systems to be financed by Rayson Brothers Logging Company. The energy conversion facilities for dryer operation are to be financed by W. R. Grace. The steam and electric production facilities will have two options, W. R. Grace or third party financing.

Coal Option: Transportation will be assumed to be contracted to contract haulers. The Dryer Energy Conversion Facilities will be W. R. Grace financed. The steam and electric production facilities will have two options, W. R. Grace & Co. or third party financing.

2. Purpose and Task Description

Identify financing alternatives available to energy suppliers and W.R. Grace & Co. The objective is to evaluate and select the most favorable financing strategy and to determine the expected cost of financing. Make preliminary contact with potential lending institutions. Include both equity and debt sources.

Product: Recommended financing stragegy

3. System Descriptions for Energy Source Options

The following is the list of parties that would be involved in the development of the proposed bioenergy facilities:

- Rayson Brothers Logging Company: a second generation independent logger operating out of Libby, Montana. This logger is this study sponsor and is interested in developing a new market to compliment its traditional logging business. Rayson Brothers can harvest both logging residues and forest residues. Additionally, Rayson Brothers' long history and business experience provides the necessary background and contacts to secure sawmill waste on a long-term basis. Rayson Brothers' objective is to execute a long-term fuel supply contract with W. R. Grace & Co.

- W. R. Grace & Company, Inc: The Libby Vermiculite mine is owned and operated by the W. R. Grace & Company, Inc., a Fortune 500 company. W. R. Grace uses an equivalant 4 megawatts of oil and 4 megawatts of electrical energy annually to mine and process vermiculite. The past decade has seen a rapid increase in oil prices and a potentially unstable world oil supply market. W. R. Grace is interested in securing a lower-cost energy supply that would not be subject to foreign influences. This is the reason wood and coal are being considered.

- Northwest Cogeneration, Inc.: An energy service company is interested in sponsoring the development of energy facilities in the event W. R. Grace & Company choose this option.

The study efforts have concluded that the following energy supply systems are the most logical solutions.

The options evaluated in this financing evaluation were selected to optimize the project financing costs and evaluate the project development from the viewpoint of an investor. In some cases, capital and operating cost data have been rounded off and/or considered as an environmental basis for evaluation purposes. Please note the assumptions carefully if the cost data is to be reconciled with data in previous tasks.

Assumptions

Cogeneration Option

Fuel Supply System

The primary fuel will be sawmill waste wood hauled in from several sawmills located in a 100-mile radius of Libby, Montana. It is assumed that for the cogeneration option, Rayson Brothers will contract with the mills and haul the mill waste to their fuel preparation and storage facility at the W. R. Grace & Co. site. Rayson Brothers will unload the trucks, process the waste wood to reduce the maximum size to 3 inches and smaller. The capital equipment for this fuel supply system is:

Fuel Transport -	Contract hauling, thus no capital required for haul trucks.
Fuel Handling & Preparation:	
Dryer operation only	- $181,500 (i)
Cogeneration	- $950,000

Note (i): All costs delivered and installed.

The back-up fuel supply will be a combination of existing oil and propane for emergency and short-term conditions. Longer term fuel shortages will be met by purchasing coal to blend with wood up to 25 percent on an emergency basis. This blending can be accommodated with no conversion of equipment to handle coal. One hundred percent coal will require additional ash handling capacity to handle the larger ash volumes with coal. Capital cost to convert to coal is estimated at $40,000 to $80,000 and would take six months.

Using coal as the primary fuel, the capital cost for the energy conversion system will increase to collect the larger volume of ash. Additionally, the other pollutants such as sulfur dioxide will require close attention so the state and federal emission limits are not exceeded. For the dryer operation it is unlikely that sulfur collection equipment will be required because of the small annual volumes of coal burned and the low sulfur content of the proposed coal. However, for cogeneration it is likely that sulfur collection devices will be required. The cost of the sulfur collection facilities is expected to range from $500,000 to $1,500,000 depending on the ruling of the Montana State Department of Health and Environment of Science. This would increase the cogeneration plant operating costs by approximately 15 percent.

Fuel Preparation & Handling System

Waste wood will be unloaded from standard chip vans on a truck dumper. The material will be run through a hog to reduce the maximum size to less than three inches. The prepared fuel will be moved to storage for use as needed. A dozer will push the wood fuel over an under-pile reclaimer for delivery to the plant fuel feeder. Blending coal, when required, up to 25 percent by energy input will be accomplished by mixing the two fuels together in the fuel storage pile with the front-end loader.

Coal fuel as the primary fuel supply source will not require an extensive fuel preparation system. Because the coal comes presized, only a de-lumper is needed to break up ice chunks and clods. A coal silo will be used to store fuel and act as a feeder.

Energy Conversion System

Wood fuel has no sulfur, one percent ash and is a waste product of local sawmills. Coal has 0.3 to 0.4 percent sulfur, 33 percent ash and is a waste product of Canadian coal mines 110 miles north of Libby. Two separate energy conversion facilities are being considered, a fluid bed burner to make hot gas to dry vermiculite from 50 percent moisture to 15 percent moisture. This hot gas generator will be located on the mountain top at the existing processing plant. The other energy conversion facility is a traditional water tube boiler and turbine-generator to generate power for the mine. Extra energy produced would be sold to the local utility.

Dryer Option Assumptions

Fuel Supply System

Rayson Brothers will purchase mill waste that is 3-inch or smaller from local sawmills. This eliminates the requirement for Rayson Brothers to invest in the capital equipment to prepare fuel in a hog. The small volume of fuel required will not carry the higher capital cost. Back-up fuel supply will be a combination of oil and propane for emergency and short-term conditions. Coal can also be used as an alternative fuel and blended up to 25 percent without any changes. The energy conversion system will be a fluid bed gasifier. This unit will produce a low BTU gas for burning in the existing boilers.

Using coal as the primary fuel requires the use of traditional coal fueled steam generator. The boiler would have to be designed for both wood and coal, otherwise the coal steam generator would operate at about 80 percent of rated output when burning all wood in the coal designed furnace.

4. The following table presents a summary of the capital requirements by system.

Comparison of Capital for Wood and Coal

Capital Cost Summary

Wood Cogeneration	$	Reference
(1) Fuel Handling	$ 950,000	(202-13)
(2) Cogen. Plant	6,540,000	(202-12,13)
	$7,490,000	
Wood Dryer		
(1) Fluid Bed Combustor	$ 646,250	(105-6)
(2) Fuel Storage (top)	264,920	(105-7)
(3) Offsite Fuel Storage	544,800	(105-8)
Coal Cogen		
(1) Boiler/T-gen	$6,540,000	(202-
(2) Fuel Handling	264,920	(105-7)
	$6,804,920	
(3) Sulfur Collection	1,000,000	(207-
	$7,804,920	
Coal Dryer		
(1) Fluid Bed Combustor	$ 646,250	(105-6)
(2) Fuel Handling	264,920	(105-7)
	911,170	
(3) SO2 Collection Equip.	500,000	(207-)
	$1,411,170	

206.5: Identify Likely Financing Methods for Project Debt and Equity by Third Parties

Project financing for the type of projects involved here can be accomplished in a number of different ways. Of paramount importance to the success of the financing effort is the contract between the parties.

Some of the financing methods available are:

A) Owner Financed

1) Use of existing W.R. Grace resources which would include: a.) excess funds available for long-term financing projects, b.) existing lines of credit; and c.) long-term institutional and public lenders.

2) Use of industrial development bonds which would most likely provide the lowest interest cost, but would entail the sacrifice of certain of the tax advantages.

B) Third-Party Financed

1) Lease of the plant by an independent leasing company to W.R. Grace.

2) Independent ownership with sale of power to W.R. Grace. This method would be necessary in order to qualify for the tax credit for use of non-conventional fuel.

In either of these instances, the third party would look to others to obtain financing. Such funds could come from a variety of sources such as:

1) Private or corporate investors
2) Institutional lenders
3) Industrial development bonds
4) Some combination of 1), 2) and 3) above, either with single party equity investors, privately placed equity among a small number of individuals, corporations or institutions or a limited partnership with a larger number of participants.

A list of prospective financing sources currently active in this market is included in Section 206.8.

6. Prepare a Base Case Financing Approach for Rayson Brothers, Third Party (NWC) and W. R. Grace & Co.

The following is a 15-year financial projection of the economic performance of each financing approach for Rayson Brothers, W. R. Grace & Co. and Northwest Cogeneration, Inc. The economic model incorporates the operating costs, financing costs and investment analysis for the various parties.

6.1 Economic Assumptions: Wood Primary Fuel

Fuel Supply System	Dryer	Cogeneration
. Annual fuel requirement at 4500 BTU/pound	12,000 tons	74,000 tons
. Wood commodity price	\$2.00/ton	\$2.00/ton
. Average transportation cost	3.50	6.80
. Processing, storage, & admin.	14.00	4.69
TOTAL FUEL COST	\$19.50/ton	\$13.49/ton
Annual Fuel Cost:	\$234,000	\$998,260
Extra Energy Sales	n/a	21,240 tons \$24.14/ton (1)
TOTAL ANNUAL FUEL COST	\$234,000	\$1,500,880
1987 Fuel Cost W Model	\$235,891 (Case #3)	\$1,665,878 (Case #1)

Note (1): Extra wood fuel reflects higher cost to travel further to purchase fuel.

6.2 Economic Assumptions: Coal Primary Fuel

Fuel Supply System	Dryer (1985)	Cogeneration
. Annual fuel requirements @ 8,000 BTU/#, 30% Ash	5300 tons	30,000 tons
. Coal commodity price	$4.00	$4.00
. Loading & Blending Cost	1.50	1.50
. Transportation Cost	9.96	9.96
TOTAL FUEL COST (FOB mine)	15.46	15.46
Annual Fuel cost (FOB mine)	$81,938	$463,800
Non-Firm Energy Sales	N/A	10,500 tons @ $15.46/ton
TOTAL ANNUAL FUEL COST	$81,938 (Case #4)	$626,130 (Case #2)

Cogeneration System:

The cogeneration facility annual operating costs for wood and coal should be very similar. The following is the operating cost summary for the 6.8 mw cogeneration facility:

. Labor & fringe benefits (15 staff) - - (non-union wages)	$250,000
. Repairs and maintenance - - - - - - - -	$250,000
. Insurance - - - - - - - - - - - - - - - - - -	$ 87,500
. Property taxes - - - - - - - - - - - - - -	$ 87,500
	$675,000/year

Management and fuel costs are not included in above estimate.

Cogeneration Revenue

W. R. Grace mine electrical consumption:

34,000,000 kw hr with \$0.029/kwh (1984 rate) (Rate includes capacity and energy)	= \$986,000
W. R. Grace dryer fuel oil	
885,000 gallons @ \$0.66381/gal	= \$587,000
TOTAL MINE ENERGY COST	\$1,573,000

POTENTIAL ELECTRIC SALES:

6.8 mw x 8760 hr x .8 less 34,000,000 kwh for mine
= 47,654,000 kwh - 34,000,000 kwh
= 13,654,000 kwh non-firm energy sales

Because energy will be delivered in non-utility peak time, night and weekends, a non-firm rate will be estimated at \$0.025 per kwh. An annual escalation factor equal to 8 percent is suggested.

Annual power sales = \$0.025 x 13,654,000 kwh
= \$341,000.

Fuel Requirement for Power Sales

	Wood	Coal
Plant Heat Rate	14,000 BTU/KWH	12,000 BTU/KWH
Energy Generated	13,654,000 KWH	13,654,000 KWH
Fuel Heat Content	4,500 Btu/#	8,000 Btu/#
Fuel Required	21,240 tons	10,241 tons

206.7: Prepare a 15-year Financial Model to Evaluate the Financial Performance of each Energy Option

The results of these financial analyses are presented in 206.10 and on the following computer analysis.

Options selected for Analysis

Using the capital and operating costs for the various alternatives presented in 206.3 to 206.6 several alternatives and combinations were evaluated through a series of iterations to develop the most favorable option for wood and coal. The best options evaluated are as follows:

Case 1: Wood cogeneration facility

Case 2: Coal cogeneration facility

Case 3: Wood dryer facility

Case 4: Coal dryer facility

CASE #1

WASTE WOOD ENERGY FACILITY-LIBBY,MT.

OPERATING FORECAST

YEAR	ENERGY SAVINGS	ENERGY SALES	GROSS REVENUE	LABOR & FRINGES	INSURANCE	REPAIRS & MAINT.	GEN.PART. MANAGEM'T	PROPERTY TAXES	FUEL TRANSPORT. PURPA	FUEL TRANSPORT. EXTRA	FUEL	TOTAL OPER.EXP	NET OPER. INCOME
1985	0	0	0	0	0	0	0	0	0	0	0	0	0
1986	0	0	0	0	0	0	0	0	0	0	0	0	0
1987	1706840	375953	2082793	250000	87500	250000	0	87500	0	0	1665878	2340878	-258085
1988	1781941	394751	2176692	262500	90125	262500	0	90125	0	0	1749172	2454422	-277730
1989	1860346	414488	2274835	275625	92829	275625	0	92829	0	0	1836630	2573538	-298703
1990	1942202	435213	2377414	289406	95614	289406	0	95614	0	0	1928462	2698502	-321088
1991	2027658	456973	2484632	303877	98482	303877	0	98482	0	0	2024865	2829602	-344971
1992	2116875	479622	2596497	319070	101436	319070	0	101436	0	0	2126129	2967143	-370446
1993	2210018	503813	2713831	335024	104480	335024	0	104480	0	0	2232436	3111443	-397612
1994	2307259	529004	2836262	351775	107614	351775	0	107614	0	0	2344058	3262836	-426573
1995	2408778	555454	2964232	369364	110842	369364	0	110842	0	0	2461261	3421673	-457441
1996	2514764	583226	3097991	387832	114168	387832	0	114168	0	0	2584324	3588323	-490332
1997	2625414	612388	3237802	407224	117593	407224	0	117593	0	0	2713540	3763172	-525371
1998	2740932	643007	3383939	427585	121120	427585	0	121120	0	0	2849217	3946627	-562688
1999	2861533	675158	3536691	448964	124754	448964	0	124754	0	0	2991678	4139114	-602423
2000	2967441	708915	3676356	471412	128497	471412	0	128497	0	0	3141261	4341079	-664723
2001	3118888	744361	3863249	494983	132352	494983	0	132352	0	0	3296324	4552993	-689744
TOTAL	35210890	8112526	43323416	5394641	1627405	5394641	0	1627405	0	0	35947254	49991346	-6667930

OPERATING ASSUMP-TIONS	% INCREASE	% INCREASE		% INCREASE	% INCREASE	% INCREASE	% G.O.I.	% INCREASE	% INCREASE	% INCREASE	% INCREASE
	1.044	1.05		1.05	1.03	1.05	0	1.03	1.05	0	1.05

CASE #2

COAL FIRED ENERGY FACILITY-LIBBY,MT.

OPERATING FORECAST

YEAR	ENERGY SAVINGS	ENERGY SALES	GROSS REVENUE	LABOR & FRINGES	INSURANCE	REPAIRS & MAINT.	GEN.PART. MANAGEM'T	PROPERTY TAXES	FUEL PURPA	TRANSPORT. EXTRA	FUEL	TOTAL OPER.EXP	NET OPER. INCOME
1985	0	0	0	0	0	0	0	0	0	0	0	0	0
1986	0	0	0	0	0	0	0	0	0	0	0	0	0
1987	1706840	375953	2082793	250000	87500	250000	0	87500	0	0	698765	1373765	709028
1988	1781941	394751	2176692	262500	90125	262500	0	90125	0	0	733703	1438953	737738
1989	1860346	414488	2274835	275625	92829	275625	0	92829	0	0	770326	1507296	767539
1990	1942202	435213	2377414	289406	95614	289406	0	95614	0	0	808908	1578948	798467
1991	2027658	456973	2484632	303877	98482	303877	0	98482	0	0	849353	1654070	830561
1992	2116875	479822	2596697	319070	101436	319070	0	101436	0	0	891821	1732335	863863
1993	2210018	503313	2713831	335024	104480	335024	0	104480	0	0	936412	1815419	898412
1994	2307259	529004	2836262	351775	107614	351775	0	127614	0	0	983133	1922011	934252
1995	2408778	555454	2964232	369364	110842	369364	0	110842	0	0	1032394	1992827	971425
1996	2514764	583226	3097991	387832	114168	387832	0	114168	0	0	1084014	2088013	1009978
1997	2625414	612388	3237602	407224	117593	407224	0	117593	0	0	1139215	2187847	1049955
1998	2740932	643007	3383939	427585	121120	427585	0	121120	0	0	1195125	2292536	1091404
1999	2861533	675158	3536691	448964	124754	448964	0	124754	0	0	1254882	2402318	1134373
2000	2987441	708915	3696356	471412	128497	471412	0	128497	0	0	1317626	2517444	1178913
2001	3118888	744361	3863249	494983	132352	494983	0	132352	0	0	1363507	2638176	1225073
TOTAL	35210890	8112526	43323416	5394641	1627405	5394641	0	1627405	0	0	15078345	29122437	14200979

OPERATING ASSUMP- TIONS	% INCREASE	% INCREASE		% INCREASE	% INCREASE	% INCREASE	% G.O.I.	% INCREASE	% INCREASE	% INCREASE	% INCREASE
	1.044	1.05		1.05	1.03	1.05	0	1.03	1.05	0	1.05

CASE #3

WOOD FIRED DRYER FACILITY-LIBBY, MT.

OPERATING FORECAST

YEAR	ENERGY SAVINGS	ENERGY SALES	GROSS REVENUE	LABOR & FRINGES	INSURANCE	REPAIRS & MAINT.	GEN.PART. MANAGEM'T	PROPERTY TAXES	FUEL TRANSPORT. PURPA	EXTRA	FUEL	TOTAL OPER.EXP	NET OPER. INCOME
1985	0	0	0	0	0	0	0	0	0	0	0	0	0
1986	0	0	0	0	0	0	0	0	0	0	0	0	0
1987	587000	0	587000	13000	5000	13000	0	5200	0	0	235491	271691	315309
1988	592870	0	592870	13650	5150	13650	0	5150	0	0	247686	285286	307584
1989	598799	0	598799	14333	5305	14333	0	5305	0	0	260070	299344	299455
1990	604787	0	604787	15049	5464	15049	0	5464	0	0	273073	314099	290688
1991	610835	0	610835	15602	5628	15602	0	5628	0	0	286727	329585	281249
1992	616943	0	616943	16592	5796	16592	0	5796	0	0	301063	345839	271104
1993	623112	0	623112	17421	5970	17421	0	5970	0	0	316117	362900	260213
1994	629343	0	629343	18292	6149	18292	0	6149	0	0	331922	380808	248535
1995	635637	0	635637	19207	6334	19207	0	6334	0	0	346538	397620	238017
1996	641993	0	641993	20167	6524	20167	0	6524	0	0	365944	419327	222667
1997	648413	0	648413	21176	6720	21176	0	6720	0	0	384242	440032	208381
1998	654897	0	654897	22234	6921	22234	0	6921	0	0	403454	461765	193132
1999	661446	0	661446	23346	7129	23346	0	7129	0	0	423626	484576	176870
2000	668061	0	668061	24513	7343	24513	0	7343	0	0	444808	508520	159541
2001	674741	0	674741	25739	7563	25739	0	7563	0	0	467048	533652	141089
TOTAL	9448878	0	9448878	280521	92995	280521	0	92995	0	0	5090189	5837221	3611657

OPERATING ASSUMPTIONS	% INCREASE	% INCREASE		% INCREASE	% INCREASE	% INCREASE	% G.O.I.	% INCREASE	% INCREASE	% INCREASE	% INCREASE		
	1.01	1.05		1.05	1.03	1.05	0	1.03	1.05	0	1.05		

CASE #4

COAL FIRED DRYER FACILITY-LIBBY,MT.

OPERATING FORECAST

YEAR	ENERGY SAVINGS	ENERGY SALES	GROSS REVENUE	LABOR & FRINGES	INSURANCE	REPAIRS & MAINT.	GEN.PART. MANAGEM'T	PROPERTY TAXES	FUEL TRANSPORT. PURPA	EXTRA	FUEL	TOTAL OPER.EXP	NET OPER. INCOME
1985	0	0	0	0	0	0	0	0	0	0	0	0	0
1986	0	0	0	0	0	0	0	0	0	0	0	0	0
1987	587000	0	587000	13000	5000	13000	0	5000	0	0	90405	126405	460595
1988	592870	0	592670	13650	5150	13650	0	5150	0	0	94925	132525	460345
1989	598799	0	598799	14333	5305	14333	0	5305	0	0	99672	138946	459853
1990	604787	0	604787	15049	5464	15049	0	5464	0	0	104655	145681	459106
1991	610835	0	610835	15802	5628	15802	0	5628	0	0	109888	152746	458088
1992	616943	0	616943	16592	5796	16592	0	5796	0	0	115382	160158	456785
1993	623112	0	623112	17421	5970	17421	0	5970	0	0	121151	167934	455178
1994	629343	0	629343	18292	6149	18292	0	6149	0	0	127209	176092	453251
1995	635637	0	635637	19207	6334	19207	0	6334	0	0	133569	184651	450986
1996	641993	0	641993	20167	6524	20167	0	6524	0	0	140248	193630	448363
1997	648413	0	648413	21176	6720	21176	0	6720	0	0	147260	203051	445363
1998	654897	0	654897	22234	6921	22234	0	6921	0	0	154623	212934	441963
1999	661446	0	661446	23346	7129	23346	0	7129	0	0	162354	223304	438142
2000	668061	0	668061	24513	7343	24513	0	7343	0	0	170472	234184	433876
2001	674741	0	674741	25739	7563	25739	0	7563	0	0	178996	245600	429142
TOTAL	9448878	0	9448878	280521	92995	280521	0	92995	0	0	1950810	2697842	6751036

OPERATING ASSUMP-TIONS	% INCREASE	% INCREASE		% INCREASE	% INCREASE	% INCREASE	% G.O.I.	% INCREASE	% INCREASE	% INCREASE	% INCREASE
	1.01	1.05		1.05	1.03	1.05	0	1.03	1.25	0	1.05

206.8 Identify Potential Lending and Financing Institutions in Support of Proposed Financing Methods

The following list contains names of banks, insurance companies, investment bankers and developers of cogeneration and energy systems:

Aetna Life & Casualty Co.
Hartford, CT

Alexander & Alexander
Indianapolis, IN

Bank of America
Capital Markets Group
San Francisco, CA

Bank of New England
Boston, MA

Bechtel Financing Services, Inc.
San Francisco, CA

Catalyst Energy Dev. Corp.
New York, NY

Chase Manhattan Bank
New York, NY

Chemical Bank
New York, NY

CIT Financial Corporation
New York, NY

Donaldson, Lufkin & Jennette
New York, NY

Equitable Investment Mgt. Corp
New York, NY

Irving Trust Company
New York, NY

Johnson & Higgins
New York, NY

Mellon Bank
Pittsburgh, PA

Merrill Lynch Capital Markets
Merrill Lynch Pierce Fenner & Smith
New York, NY

Morgan Grenfell
New York, NY

Morgan Guaranty Trust Co.
New York, NY

Morgan Stanley & Co., Inc.
New York, NY

New England Mutual Life Ins. Co
Boston, MA

Northwest Cogeneration, Inc
Spokane, WA

Pru Capital, Inc
Prudential Insurance Co.
Newark, NJ

Rainier Bank
Seattle, WA

General Electric Credit Corp
Stamford, CT

Home Life Insurance Company
New York, NY

E. F. Hutton Credit Corp.
Greenwich, CT

Institute for Energy Funding,Ltd.
New York, NY

Siemens Capital Corp
New York, NY

Time Energy, Inc.
Dallas, Texas

Travelers Insurance Co.
Hartford, CT

Ultrasystems
Los Angeles, CA

Union Bank
Los Angeles, CA

Wells Fargo Capital Markets
San Francisco, CA

206.9: Make Preliminary Contact with Potential Financing Sources and Document Their Interest in Participating in this Project Financing

To identify specific parties with specific interest in cogeneration and waste wood fueled project financing, the November 8-9, 1984 "Investing In Cogeneration Conference" sponsored by The Energy Bureau in Arlington, Virginia was attended. This conference presented formal papers, and round table discussions were held on financing and investing in cogeneration and waste fueled projects.

The conclusion reached in these discussions and contact with potential financing sources has revealed that documentation of a specific project is necessary before any financing commitments can be obtained. After Rayson Brothers and W.R. Grace have executed an agreement, financing institutions will be in a position to make specific commitments for the financing of the proposed energy facility. It would be premature and non-productive to make further financing inquiries until such agreement is reached.

206.10: Prepare a Summary of Expected Cost of Financing by Energy Option

For financial analysis purposes, four alternatives have been reviewed. These are:

1.) Electrical generating plant utilizing wood waste as a primary fuel source;

2.) Electrical generating plant utilizing coal as a primary fuel source;

3.) Vermiculite dryer utilizing wood waste as a primary fuel source; and

4.) Vermiculite dryer utilizing coal as a primary fuel source.

Please see Schedule A for the assumptions used for each of these cases.

Conclusion

Cases #2 and #4 above were compared with Cases #1 and #3, respectively. In both instances it was found that coal was the least expensive fuel source. However, if W.R. Grace is willing to contract with a third party to supply gas produced from wood, then an attractive alternative to Case #3 would exist. Depending upon the arrangement worked out between the parties, Case #3, as modified, could be less expensive to W.R. Grace than Case #4.

Discussion of Electrical Generating Plant

In regard to Case #1 it was found that the use of wood waste, at the price quoted, produced an operating loss in each of the 15 years forecast before any debt service or recovery of capital costs. This is in sharp contrast to the forecast results of Case #2 which reflects growing operating income over the same 15-year period. Similar revenue and expense assumptions were used in each case, with the cost of fuel being the primary determinant of the dramatic difference in net operating income.

It appears that the best financing alternative for either the wood or the coal fired plant would be industrial development bonds, assuming they are available for such use in Montana at the time of construction. For financial modeling purposes, bonds equal to 90% of cost were amortized over a 25-year period at 10% interest. For the coal fired plant, in each year a positive cash flow is produced, providing for a very attractive return on the equity invested.

Since Case #1 produced negative operating results throughout its life, it made no sense to look at the financing or after tax implications for this alternative.

Discussion of Vermiculite Dryer

Because of significantly lower fuel and base capital costs, the coal fired dryer (Case #4) is clearly superior to the wood waste fired dryer (Case #3). However, it would be possible for Rayson Bros. to present an attractive option to coal to W.R. Grace, using wood to produce gas, which in turn would fire the dryer. In this event, Rayson would be in a position to obtain significant tax credits under Section 44D of the Internal Revenue Code. To the extent these could be used to offset tax liabilities that Rayson (or a partnership set up to own the equipment) would otherwise pay, a large portion of the benefit could be passed to W.R. Grace in the form of reduced energy costs. Because of the requirements of the particular tax code section, Grace could not obtain this credit by itself, but could conceivably have up to a 50% ownership interest in the facility.

Schedule A

W. R. GRACE
LIBBY, MONTANA STUDY
ASSUMPTIONS

	COGENERATION		DRYER	
	Wood #1	Coal #2	Wood #3	Coal #4
Operating Assumptions:				
Energy Savings Escalation Rate:				
Gas	1%	1%	1%	1%
Electric	10%	10%	n/a	n/a
Combined	4.4%	4.4%	1%	1%
Electricity Sales Escalation Rate	5%	5%	n/a	n/a
Fuel Escalation Rates	5%	5%	5%	5%
Operating Expense Escalation Rate	5%	5%	5%	5%
Insurance & Property Tax Escalation Rate	3%	3%	3%	3%
Financing Assumptions:				
Cost (1)	8,000,000	7,000,000	1,550,000	975,000-1,500,000
% Financed	n/a	90%	66.7%	66.7%
Interest Rate	n/a	10%	14%	14%
Loan Term	n/a	25 years	10 years	10 years

Note (1): Includes construction cost, interest during construction and financing cost.

Tax Assumptions

Tax Rate	n/a	50%	50%	50%
Depreciation Term	n/a	18 years	5 years	
Gasification Credit (% Plant Cost/Yr)	n/a	-0-	8%	-0-

206.11: References

- J. Stephen Schaub
  J. S. Schaub & Co., Inc.
  Registered Financial Advisor
  Securities & Exchange Commission and
  State of Washington
  Spokane, Washington

TASK NO: 207: ENVIRONMENTAL REQUIREMENTS

Task Management Information

Libby Bioenergy Project

Activity Schedule

Task Start Date: October 22, 1984
Task Completion Date: December 10, 1984

Personnel Working on Task

Name	Company	Phone No.
Task Leader		
Jerrie Little	Resource Development Associates	509-838-8024
Clayton Rayson	Rayson Brothers Logging	406-293-9306
Mike Ray	W. R. Grace	406-293-3746
Ken Briggeman	USFS	406-293-6211
Jerry Parks	USFS	406-293-6211
Ned Dye	Omicron	206-392-0676

Prime Contractor		
Clayton Rayson	Rayson Bros. Logging	406-293-9306
Project Manager		
Dave Van Hersett	Resource Dev. Assoc.	509-838-8024

207: Prepare the environmental requirements limitations for each energy option. Specifically identify any concerns that may potentially interfere with the orderly development of the project. Define the emission requirements by emission source by permit. Discuss emission control systems and/or methods to be used to ensure compliance.

Product: Emissions requirements listing by permit by emission source. Discussion of significant items as identified.

A: Task Report Table of Contents

1. Introduction
2. Purpose and Task Description
3. Energy Options Systems Description
4. Environmental Requirements Limitations For Each Energy Option
5. Identify Major Concerns That May Potentially Interfere With The Orderly Development of the Project
6. Defuse Emission Requirements By Emission Permit
7. Describe Emission Control Systems and/or Methods to be Used to Ensure Compliance
8. Summary List of Permits For Each Energy Option

TASK 207 - ENVIRONMENTAL LIMITATIONS

EXECUTIVE SUMMARY

Very few environmental limitations were uncovered in discussions with agency and permitting officials. The area air quality is poor due to the mountainous topography of the area but by utilizing pollution control equipment, emissions can be limited, and permitting should be no problem.

Another issue is the rainbow trout population in the Kootenai River. The Corp of Engineers maintain strict water temperature limitations on the river; however, the amount of cooled wastewater being discharged into the river would not affect the river temperature.

Prior to construction, several of the permits require public notice.

Enviromnental Assessmant

1. Introduction

The construction of two independent generating stations has been proposed: (1) a 6 megawatt electric-steam generating plant, which will produce electricity to be sold to an electric utility, and (2) hot gas generator which will produce sufficient hot gas to operate the dryers at the W. R. Grace vermiculite mine. The two options will replace the existing oil burning units that heat the dryers, and option No. 1 will also offset the 6 MWs of electric energy consumed by W. R. Grace and Company.

The proposed plants will be fueled with either coal or a combination of millwaste and forest residue. For start-up purposes only, No. 2 diesel fuel will be used.

The purpose of this environmental assessment is presented in two parts:

Part A addresses the 6 MW electric-steam generating plant located at the site near the Kootenai River, and Part B addresses the small Fluid Bed Combustor that will be located on Vermiculite Mountain and will supply hot gas to the mine dryers.

Part A--6 MW Steam/Electric Generation Facility

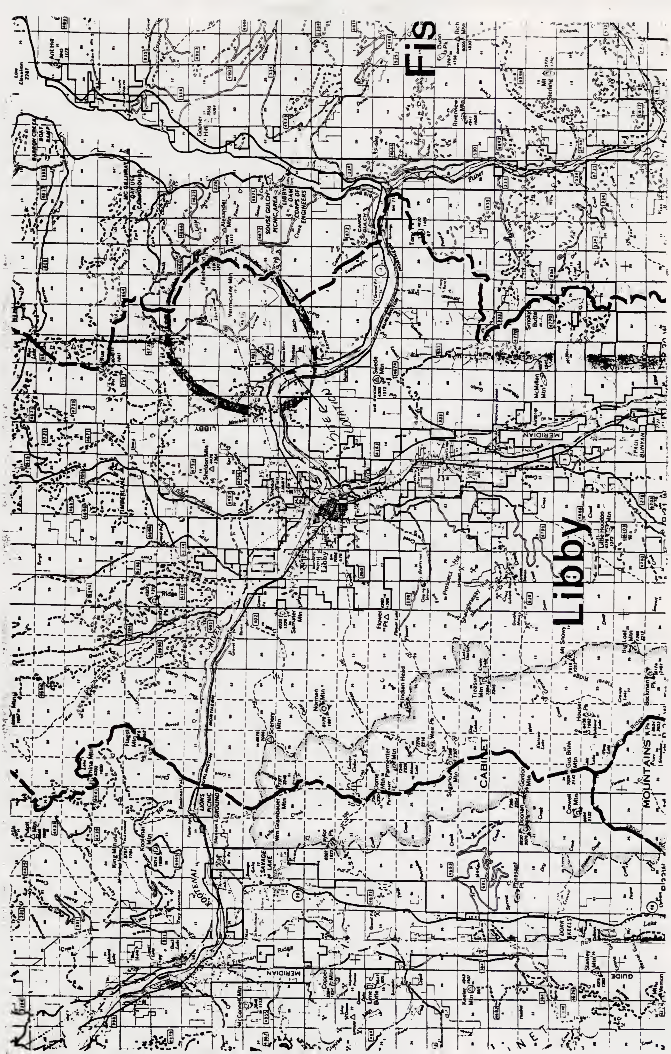
The facility site location is shown on Figure 1. The site is between the Kootenai River and Highway 37 directly east of the W. R. Grace processing plant.

Earth (Geology, Soils and Topography)

As shown Figure 1-A, the topography of the site is gently sloped downward from U.S. 37 to the Kootenai River. Grading at the site will modify the existing topography. However, the amount of area and extent of grading effects are expected to be minimal. Portions of the site within 200 feet of the Kootenai River are within the 100-year flood plain. Therefore, prior to construction, plans will be reviewed by Lincoln County officials.

The site is located in Seismic Zone II of the Uniform Building Code Seismic Risk Map of the United States. This corresponds to an Intensity VII earthquake on the Modified Mercalli Scale, and structures on the site must be designed to withstand corresponding vibratory forces.

The soil bearing capability of the site is suitable for spread footings. The impact on geology and soils will be the same regardless of the fuel type.


Libby
Fis
CABINET
MOUNTAINS
KOOTENAI
RIVER
NORTHERN
BURLINGTON
LIONS PICNIC GROUND
MERIDIAN
PAUL BUNYAN
GUIDE
LIBBY
SOUSE GULCH PICNIC AREA
LIBBY DAM CORPS OF ENGINEERS
MC GILLIVRAY CAMPGROUND
BARRON CREEK BOAT RAMP
TIMBERLANE
Vermiculite Mtn
Alexander Mtn
Sheldon Mtn
Flower Pt
Treasure Mtn
Indian Head
Scenery Mtn
Norman Mtn
Mt Snowy
Big Loaf Mtn
Bockman Pk
Gus Brink Mtn
Crowell Mtn
Sugarloaf Mtn
Dome Mtn
Parmenter Mtn
Smoky Butte
McMillan Mtn
Little Hoodoo Mtn
Riverview Mtn
Mt Sterling
Dunn Pk
Rich Mtn
Gopher Hill
Ant Hill
Kootenai Mtn
King Mtn
Stanley Mtn
Keeler Mtn
Lime Butte
McConnell Mtn
Freeman Ridge
Shaughnessy Hill
Prospect Hill
Savage Lake
Fisher

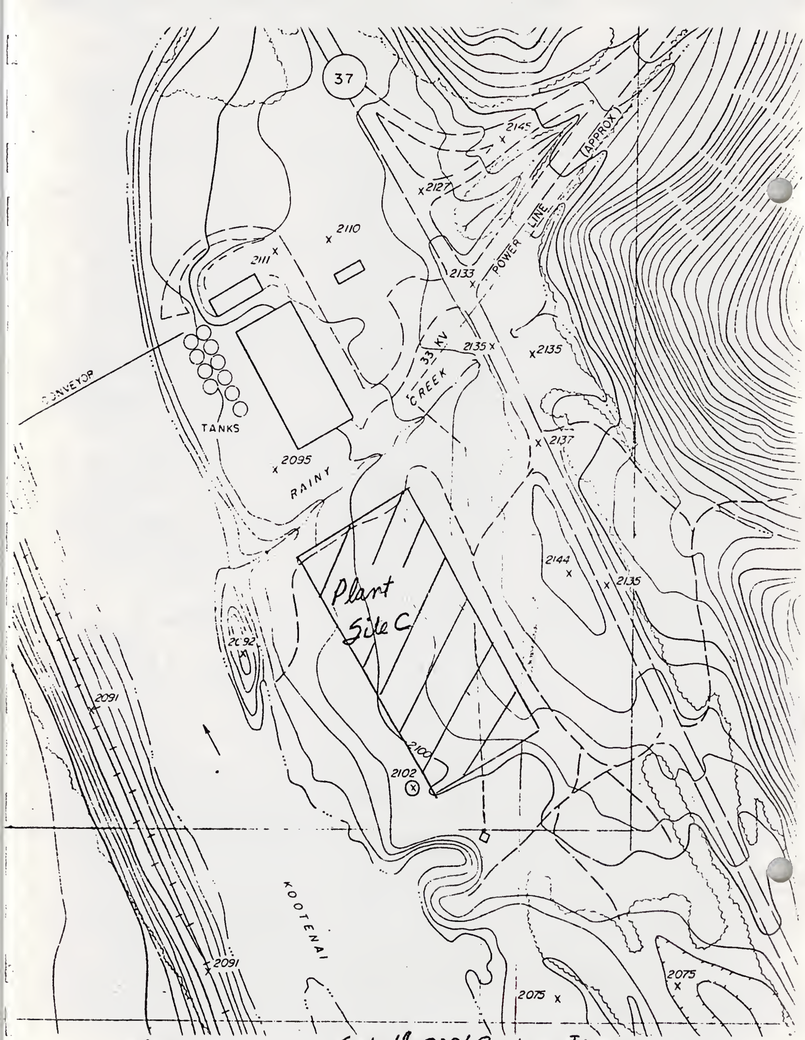


FIGURE 1-A Scale 1" = 200' Contour Interval 10 ft

Population and Socioeconomics

The plant site is located in a rural area approximately five miles east of Libby, Montana. The current population of Libby is 2,748 people. Primary employers of the area are the W. R. Grace Mine, the U.S. Forest Service, and the forest products industry.

Regardless of fuel type, the plant will require a peak construction force of ten people and an operating staff of about three people. Where possible, employees would be hired locally.

Some opportunity for employment will occur as a result of the fuel supply. Regardless of the fuel type, deliveries will be made by truck. If coal is used, drivers will be necessary to deliver the three to five loads a day from Canada. If wood is used, drivers will deliver the eight to twelve loads per day from area mills and forests, and additional employment would result from in-the-forest residue recovery operations.

Traffic

Millwaste and forest residue will be delivered in 24-ton loads either by vans or logging trucks. The major service road to the site is State Highway 37, a two-lane highway.

A one-way access loop into the site and fuel delivery area, with a separate entrance and exit off Highway 37, will be constructed. Delivery trucks will follow the road through the drive-through scale, to the truck dump area and then back to Highway 37 without any turnarounds.

The estimated traffic flow on Highway 37 as a result of fuel deliveries will be:

Summer Season	Loads Per Day	Loads During Peak Hour
Coal	5	1
Wood	12	2
Winter Season		
Coal	3	1
Wood	8	2

The transportation distance for coal is 120 miles one-way. The maximum haul distance for forest residue is 50 one-way miles, and the average haul distance for millwaste is 60 to 100 one-way miles.

Wood transportation will make the most impact on the section of Highway 37 near the site, but at 12 loads per day, the impact will be minimal.

Land Use

The proposed site is located in a rural area with other industrial operations nearby. Adjacent to the site is a processing plant for the W. R. Grace vermiculite operation. This project will provide steam to the adjacent processing plant. The plant site as it exists is a vacant area near the Kootenai River with some domestic fruit trees scattered among the natural vegetation.

This project, regardless of the fuel type, will not interfere with any other intended use for the land.

In-the-forest recovery operations, if woodwaste is used as fuel, will have a positive impact on area forest lands. Thinning of stands and clean-up operations will be feasible, and forest managers will have the means to implement forest improvement programs.

Fish and Wildlife

The area of the site is populated with a variety of large animals. The most predominate species on the site is the whitetail deer. This animal can be spotted at any time of year in the area of the site. Mule deer occasionally are spotted in this area near the Kootenai River during the spring. During summer and fall, black bear are known to feed on apple trees on the site. On either side of the site (across the river or across the highway in Rainy Creek), moose have been spotted. It is possible that these moose may also cross through the site area. Elk can be found across the highway in the Rainy Creek area, but it would be uncommon for one to cross the highway.

The plant construction should have little impact on any of these species. During construction, relocation of animals on the site may be necessary.

The Kootenai River is heavily populated with rainbow trout. Also, mountain whitefish, a few cutthroat, some bulltrout, and a small population of burbot frequent the river. Because of the rainbow trout in the river, there is a strict temperature requirement for water flowing over the Libby Dams. However, the discharge of cooled wastewater from the plant should not have a significant effect on river water temperature because of the volume of river water versus the volume of discharged water. Care should be taken, however, not to disturb water temperature on the insect population within this area.

Aesthetics

The site is along the Kootenai River in a scenic, rural area between Libby, Montana and the Libby Dam and is visible from Highway 37. There are other industrial facilities scattered along the river.

During design and construction of the plant, focus will be given to the visual impact of the finished plant. Appropriate colors and materials will be chosen and, where possible, vegetation and topography will be left in its natural state.

If coal is used as fuel, it would be stored in silos. Millwaste and forest residue would be stored in a managed, three-acre woodwaste pile and log deck. In either case, the silos and the woodwaste storage area would be seen by passersby on Highway 37; however, both are common sights at other Pacific Northwest sawmills and industrial operations in this region.

Cultural Resources

Prior to construction, a file search to locate any historical recordings on the site should be completed. The request should be sent to the Montana Historical Society, Helena, Montana along with a description of the project and the anticipated ground disturbance.

Air Quality

Air quality within the Libby, Montana area is affected by the mountainous terrain throughout the area. This is true in the area of the site. Emissions from this plant will not be substantial regardless of the fuel type, and permitting should be relatively easy. Through fairly sophisticated technology (BACT), the plant will not cause degradation to the existing air quality.

Sulfur Oxide Impact

The sulfur content of the coal is 0.3 percent. This would produce 0.38 pounds of sulfur per million BTU fired. Coal normally produced in Montana has a sulfur content that ranges 0.7 to 2.5 percent. A recent coal fueled plant under construction at Malstrom Air Force Base was required to install a flue gas desulfurization system capable of collecting 70 percent of the sulfur emissions. The coal being used has a sulfur content ranging from 0.7 to 1.0 percent sulfur. Because the sulfur content is so low, no significant impact is foreseen, and the necessity for sulfur collection equipment is questionable.

Part B--Fluid Bed Combustor For Dryer Hot Gas

This facility will be located at the top of Vermiculite Mountain at the site shown on Figure 2. The site is presently occupied by the existing operating W. R. Grace vermiculite mine. The woodwaste or coal-fired generator would provide hot gas for the mine vermiculite dryers, replacing the existing oil/gas-fired unit.

Earth

The site is an existing mining operation, and little or no earth work will be required to convert the boiler to wood or coal. The site has been permitted for the mining operation. It is also located in Seismic Zone II of the Uniform Building Code Seismic Risk Map of the United States, and the design should withstand the corresponding vibratory forces.

Other construction at the site would indicate suitable soil bearing capability.

Population and Socioeconomics

This plant would have little effect on area population and economics. No additional staff would be required to operate the plant. Some employment opportunities within the local labor force would occur as a result of woodwaste fuel delivery and recovery operations. Fifty-eight tons of woodwaste per day will be required to fuel the plant, or two to three truck loads per day.

In the case of coal, no additional staff would be required with the exception of the possible fuel delivery person who would deliver the one load of coal per day required to fuel the plant.

Traffic

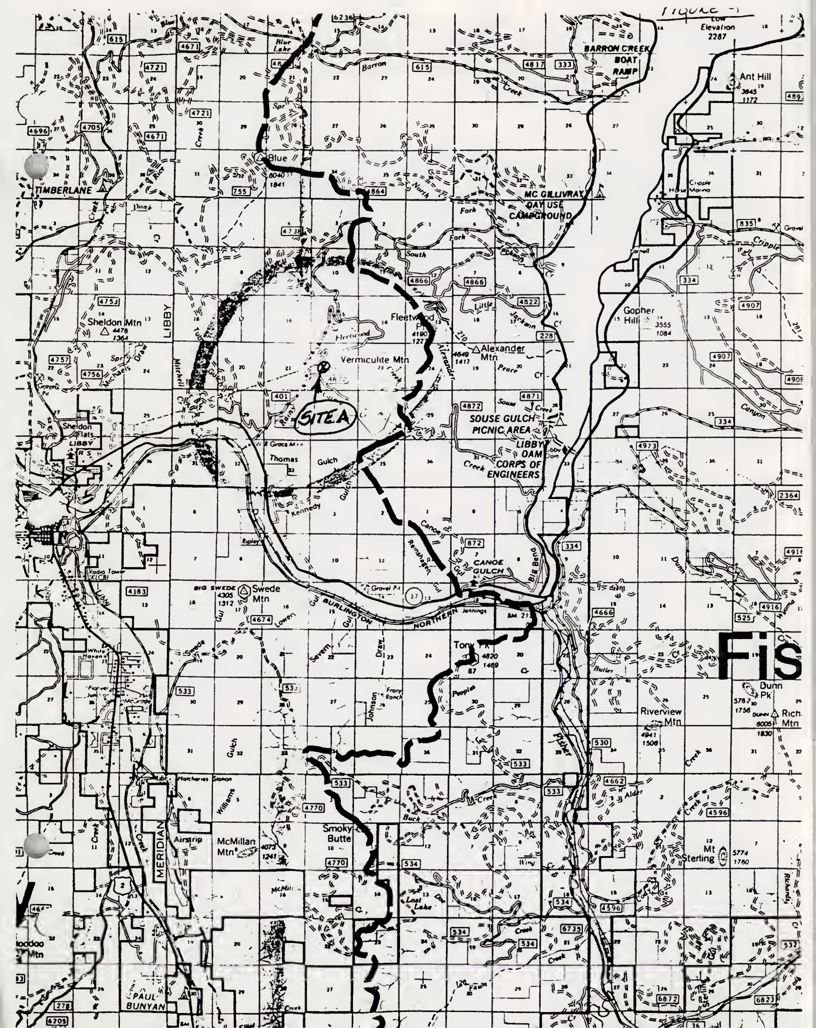
Little to no impact would occur to traffic on Highway 37. As mentioned above, if woodwaste is used, two or three trucks per day would deliver fuel. One truck per day would deliver coal if it is used for fuel. The existing, well-cared-for dirt access road to the mine from Highway 37 will be utilized for coal or wood deliveries.

Air Quality

If wood is used to fuel the plant, the impact to air quality would be insignificant. The amount of fuel burned is small (12,000 tons per year), and the expected emission levels without any pollution control equipment utilized at all would still be below the level that EPA uses to qualify a source as a major stationary source. It would, however, require a permit from Montana State, and standards would have to be met. Pollution control equipment will be required.

If coal is used to fuel this plant, the impact to air quality would be insignificant. The amount of fuel burned is small, 30,000 tons per year, and the expected emission levels without any pollution control equipment utilized at all would still be below the level that EPA uses to qualify a source as a major stationary source. It would, however, require a permit from Montana State, and standards would have to be met.

Pollution control equipment for particulates will be required. Because the sulfur content of the coal is so low (0.3%), sulfur collection equipment may not be required. Recent new stationary emissions sources using coal with 0.8% to 1% sulfur were required to install sulfur dioxide removal equipment.


SITE A
Low Elevation 2287
BARRON CREEK BOAT RAMP
Ant Hill
Blue Lake
Barron Creek
Blue Mtn 6040 1841
TIMBERLANE
MC GILLIVRAY DAY USE CAMPGROUND
North Fork
South Fork
Fleetwood Pk 4190 1277
Vermiculite Mtn
Alexander Mtn 4649 1417
Sheldon Mtn 4478 1364
LIBBY
Sheldon Flats
Libby R.S.
SOUSE GULCH PICNIC AREA
LIBBY DAM CORPS OF ENGINEERS
Gopher Hill 3555 1084
Thomas Gulch
Kennedy Gulch
Canoe Gulch
CANOE GULCH
Big Bend
Rainy Creek
Jackson Cr
Peace Cr
Canyon Creek
BIG SWEDE 4305 1312 Swede Mtn
BURLINGTON NORTHERN
Jennings
Tony Pk 4820 1469
Peoples Cr
Radio Tower (KLCB)
White Haven
Riverview Mtn 4941 1506
Dunn Pk 5782 1756
Rich. Mtn 6005 1830
Smoky Butte
McMillan Mtn 4073 1241
Airstrip
MERIDIAN
Mt Sterling 5774 1760
Lost Lake
Buck Cr
Alder Creek
Fisher
PAUL BUNYAN
Hoodoo Mtn
Fis

Other Impacts

This plant would have little or no impact other than environmental impacts. The land is used for the existing vermiculite mine and is well within private property at a location not visible to the public. No impact would occur to fish or wildlife in addition to the existing operation.

TASK 207-7: DESCRIPTION OF THE EMISSION CONTROL SYSTEMS

Descriptions of the emission control systems for the fluidized bed combustor and the cogeneration power plant are presented in Task 202, Item 5.

TASK NO: 208: IDENTIFY SITES

TASK MANAGEMENT INFORMATION

LIBBY BIOENERGY PROJECT

Activity Schedule

Task Start Date:	October 22, 1984
Task Completion Date:	December 10, 1984

Personnel Working on Task

Name	Company	Phone No.
Task Leader Jerrie Little	Resource Dev. Assoc.	509-838-8024
Clayton Rayson	Rayson Brothers Logging	406-293-9306
Mike Ray	W. R. Grace	406-293-3746
Ken Briggeman	USFS	406-293-6211
Jerry Parks	USFS	406-293-6211
Prime Contractor Clayton Rayson	Rayson Bros Logging	406-293-9306
Project Manager Dave Van Hersett	Resource Dev. Assoc.	509-838-8024

208: Identify Sites

INTRODUCTION:

Working with the W.R. Grace staff, three potential sites were identified. These sites were selected because they are located adjacent to the mine's major processing facilities. The nature of the energy conversion equipment requires that it be located next to the energy using facility. The sites were also located to facilitate the delivery of bulk fuels - wood and coal.

Task Description

For the preceding sites selected, prepare the following site evaluation data:

- Soil Conditions for Foundations
- Accessibility
- Utilities
- Ownership
- Weather Data
- Hydrology
- Land Use
- Population Density

Accessibility

All sites are accessable by the existing mine service road system. No major road construction would be necessary for any of the sites.

Land Use

All sites are on private property owned by W.R. Grace & Company. Sites A and C are on or adjacent to existing mine processing buildings. Site B is adjacent to the existing mine water wells.

Utilities

All three sites are served by the same electric utility, Pacific Power & Light Co. The mine has its own water supply system. Oil and propane are purchased from local suppliers.

Population Density

The nearest population center is Libby, Montana, located seven miles downstream to the west. W.R. Grace & Co. owns ______ acres. The mine is located in the middle of this property.

	Site A	Site B	Site C
Location:	Mountain top	Near mine water wells	Adjacent to product storage
Elevation:	3600 ft.	2700 ft.	2130 ft.
Soil Conditions for Foundation	Spread footings 3500 psf	Drill site to confirm spread footings	Spread footings 3500 psf
Weather Date (Refer to task 209)	Mountain top conditions. Similar to Libby, MT. Winter low (-20°F) Summer high (80°F)	Use Libby, Mt. data	Use weather data from Libby, MT.
Hydrology	No water table. Water to be supplied by existing mine water system.	Valley location downstream of mine settling ponds. Typical silt-filled valley floor. Water table 10 feet below grade.	Typical glacial fill of sediment and rocks. Site was a former apple orchard. Water table influenced by nearby river. Water to be supplied by existing mine water system.

Ownership

All three sites are located on property owned by W.R. Grace & Company.

Site Arrangements

Site A: Refer to Drawing 202-10 in Task 202
Site B: Because Sites A and C are the preferred sites, no arrangement was prepared for Site B.
Site C: Refer to Drawing 202-11, 202-12 and 202-13 in Task 201.

TASK NO: 209: SITE ENVIRONMENTAL ASSESSMENT

TASK MANAGEMENT INFORMATION

LIBBY BIOENERGY PROJECT

Activity Schedule

Task Start Date: November 22, 1984
Task Completion Date: December 10, 1984

Personnel Working on Task

Name	Company	Phone No.
Task Leader		
Jerrie Little	Resource Dev. Assoc	509-838-8024
Clayton Rayson	Rayson Bros. Loggins	406-293-9306
Mike Ray	W. R. Grace	406-293-3746
Ken Briggeman	USFS	406-293-6211
Jerry Parks	USFS	406-293-6211
Ned Dye	Omicron	206-392-0676

PRIME CONTRACTOR		
Clayton Rayson	Rayson Bros. Logging	406-293-9306
Project Manager		
Dave Van Hersett	Resource Dev. Assoc	509-838-8024

A: Task Report Table of Contents

1. Introduction
2. Task Description
3. Site Location Map
4. Description of Energy Conversion System By Energy Option
5. Prepare Environmental Assessment For Each Site Using Phase I, Task 111 Guidelines.
6. Secure Copies of Environmental Baseline Data Such as Weather Data
7. Contact and/or Identify Local Environmental Organizations
8. Document Potential Concerns of Interested Parties

209: Site Environmental Assessment

1. Introduction

The site selection has been narrowed down to two sites. The sites are: Site A - Mountain top for the dryer application and Site C - Adjacent to the mine product storage facilities. Site C can accommodate either the dryer only option or the cogeneration option.

2. Task Description

Prepare an environmental assessment for each energy facility site. Use the State environmental guidelines and checklist to prepare the environmental assessment. Locate all applicable base line environmental organizations and tribal groups that would have potential concerns about the project. Prepare information and make presentations as required to respond to concerns of interested parties.

Product: An environmental assessment for each facility site.

3. Site Location Map (Refer to Task 207: Figure 1, 1-A and Figure 2)

4. Description of Energy Conversion System by Energy Option

Wood Fuel - Dryer Only: Refer to Task 105, Paragraph 2 for the description of the wood fueled - dryer only system. This system can be located at either Site A or C.

Wood Fuel - Cogeneration: Refer to Task 202, Paragraph 3, page 202-5, for the description of the wood fueled - cogeneration systems. This system can only be located at Site C.

Coal Fuel - Dryer Only: The system description is the same as the wood fueled system with the addition of the following changes to accommodate coal: fuel feeder, ash handling and the potential addition of desulfurization equipment to collect sulfur.

Coal Fuel - Cogeneration: The system description is the same as wood fueled system with the addition of the following changes to accommodate coal: fuel feeder, fuel silo, ash handling and the potential addition of desulfurization equipment to collect sulfur.

5. Site Environmental Assessment

The environmental assessment is presented in Task 207 by area of concern. Refer to Task 207 for detailed information.

6. Environmental Baseline Data

Weather data for Libby, Montana was secured from the National Climate Data Center and is included in the following pages. The data includes precipitation, temperature (averages and extremes, seasonal cooling degree days, soil temperatures, evaporation, and wind).

7. Local Environmental Organizations Contacted

Refer to Task No. 205: References section. Some of the organizations contacted include the following:

- Montana Fish and Game
- Montana Historical Society
- University of Montana, Anthropology Dept.
- Game Agent
- Department of Health and Environmental Sciences (air and water quality)
- Soil Conservation Service
- U.S. Forest Service

8. Potential Concerns of Interested Parties

Detailed results of the environmental concerns are presented in the preceding tasks as follows:

Task	Subject
111	Environmental Assessment
205	License Applications
207	Environmental Requirements

All of the concerns of the interested parties are documented and addressed in these tasks.

Conclusions

By following the required licensing procedures identified, the proposed energy conversion systems can be constructed and operated in compliance with the environmental regulations. No barriers were uncovered that would prohibit the orderly development of the project. The only area identified that would have a significant impact on the economic viability of the proposed project is the potential requirement to collect sulfur in the stack gas if coal is used. Because the proposed coal has very low sulfur (0.3%), there may be no need for a $500,000 to $1,500,000 flue gas desulfurization system. This requirement would be made at the time an application is processed by the State.

ISSN 0145-0395

CLIMATOLOGICAL DATA ANNUAL SUMMARY

MONTANA

1983

VOLUME 86 NUMBER 13

DEPARTMENT OF COMMERCE ☆ UNITED STATES OF AMERICA ☆

"I CERTIFY THAT THIS IS AN OFFICIAL PUBLICATION OF THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION AND IS COMPILED FROM INFORMATION RECEIVED AT THE NATIONAL CLIMATIC DATA CENTER, ASHEVILLE NORTH CAROLINA" 28801

L Ray Hoxit

ACTING DIRECTOR
NATIONAL CLIMATIC DATA CENTER

noaa

NATIONAL
OCEANIC AND
ATMOSPHERIC ADMINISTRATION

NATIONAL
ENVIRONMENTAL SATELLITE, DATA
AND INFORMATION SERVICE

NATIONAL
CLIMATIC DATA CENTER
ASHEVILLE NORTH CAROLINA

209-5

1983 - Annual Summ

TOTAL PRECIPITATION AND DEPARTURE. FROM NORMAL (INCHES)

209-6

STATION	JAN		FEB		MAR		APR		MAY		JUN	
	PRECIP	DEPARTURE	PRECIP	DEPARTURE	PRECIP	DEPARTURE	PRECIP	DEPARTURE	PRECIP	DEPARTURE	PRECIP	DEPARTURE
MONTANA												
WESTERN 01												
ANACONDA	.30		.28		1.14		1.04		1.51		1.21	
BIGFORK 13 S	.37	-1.83	1.38	.01	2.33	1.09	1.93	.47	1.86	-.52	5.26	2.28
CRESTON	.93	-.62	.85	.28	1.71	.72	2.41	1.05	1.20	-1.06	2.96	.14
DARBY	1.46	-.26	.60	.47	.60	.36	.19	-.92	1.24	-.69	1.47	-.33
DRUMMOND AVIATION	.49		.51		.66		.74		1.79		2.08	
EUREKA RANGER STATION	1.01		.98		1.99		2.07		.52		2.60	
FORTINE 1 N	.94	-.61	.69	-.33	1.50	.53	2.59	1.43	.58	-1.54	2.10	-.18
HAMILTON	1.02	-.29	.78	.06	.68	-.03	.46	-.46	1.31	-.37	1.39	-.35
HAUGAN 3 E	3.89	-.99	3.44	.10	2.81	.08	.49	-1.44	1.26	-.63	2.49	.56
HERON 2 NW	4.88	-.23	2.92	-.70	3.59	1.02	1.35	-.60	1.68	-.69	3.96	1.26
HOT SPRINGS	1.61		1.34		1.31		.52		.64		3.19	
HUNGRY HORSE DAM	2.51	-1.32	1.67	-.99	2.31	.11	2.46	.33	.97	-1.77	3.78	.59
KALISPELL WSO AP R	1.09	-.53	.93	-.13	1.50	.66	2.18	1.12	.78	-.98	3.09	.85
KILA 9 SSW	M		M		M		M		M		M	
LIBBY DAM	.99		.48		1.34		1.62		.72		2.37	
LIBBY 1 NE RANGER STN	2.40	-.18	1.14	-.43	1.97	.75	1.05	-.02	.50	-1.00	1.73	.18
LIBBY 32 SSE	3.42		1.68		1.87		.78		1.15		2.60	
LINDBERGH LAKE	3.06		1.82		1.48		.44		1.79		3.02	
MISSOULA 2 NE	.62		1.57		1.32		.98		3.15		2.76	
MISSOULA WSO AP //R	.62	-.79	.95	.14	1.10	.27	.72	-.29	2.65	1.03	2.26	.41
OLNEY	2.88		3.08		2.17		3.00		1.03		3.03	
OVANDO 9 SSE	1.09		.82		.52		.64		1.47		1.02	
PHILIPSBURG RANGER STN	.47	-.30	.15	-.32	.86	.12	.58	-.66	1.52	-.65	2.24	-.31
POLEBRIDGE	2.38	-.65	1.14	-.90	1.87	.40	1.12	-.29	.29	-1.64	2.98	.60
POLSON	.53		.91		1.35		.93		1.85		3.34	
POLSON KERR DAM	.49	-.80	.83	-.06	1.55	.80	1.16	.00	2.00	-.07	3.52	1.34
POTOMAC	1.25		1.37		.42		.44		1.73		1.70	
SAINT IGNATIUS	.18	-1.16	.59	-.19	.97	.00	1.08	-.35	2.61	.27	4.19	1.66
SAINT REGIS RANGER STA	2.14		2.34		1.80		.91		1.45		2.68	
SEELEY LAKE RANGER STA	2.13	-1.12	1.57	-.27	.63	-1.04	.45	-.93	2.20	.29	2.38	.19
SILVER LAKE	.56	-.64	.28	-.65	2.34	.87	1.36	-.54	2.45	-.10	2.24	-.76
STEVENSVILLE	.89	-.56	1.00	.14	.52	-.23	.24	-.54	.84	-.67	1.25	-.40
SULA 3 ENE	.96		.35		1.13		.86		1.39		1.88	
SUPERIOR	1.09	-1.08	.96	-.27	1.15	-.20	.64	-.63	1.76	-.04	2.64	.78
SWAN LAKE	1.18		2.03		1.92		1.32		1.74		2.48	
THOMPSON FALLS P H	3.09	.04	1.76	-.27	1.71	-.12	.64	-.93	1.66	-.20	3.95	2.04
TROUT CREEK RANGER STA	4.05	-.90	2.71	-.61	3.40	.89	.90	-.94	1.53	-.49	3.21	1.18
TROY	4.00		2.06		3.09		1.17		.92		3.15	
TROY 18 N	6.32		3.33		3.43		2.37		1.40		3.19	
WESTERN MONTANA BR STN	.30		.44		.55		.46		1.54		1.10	
WEST GLACIER	4.36	.75	1.41	-1.20	1.90	.12	1.43	-.36	.96	-1.61	4.41	1.17
WHITEFISH 5 NW	1.74	-.70	1.40	-.41	2.14	.81	1.92	.36	.91	-1.57	4.53	1.44
--DIVISIONAL DATA-------->	1.79	-.56	1.33	-.21	1.59	.26	1.14	-.21	1.42	-.55	2.63	.42
SOUTHWESTERN 02												
ALDER 17 S	.07		.09		.79		.64		1.04		3.63	
ALDER RUBY DAM	.08		1.05		.89		.63		1.40		4.22	
BELGRADE AIRPORT	.07	-.59	.27	-.20	.71	-.18	1.60	.46	1.73	-.50	2.99	.54
BOZEMAN MT ST UNIV	.12	-.79	.58	-.05	1.35	-.04	2.02	.20	2.46	-.48	2.87	-.03
BOZEMAN 6 W EXP FARM	.10		.35		.88		1.14		1.87		3.31	
BOZEMAN 12 NE	1.28	-1.58	1.80	-.38	2.69	-.01	2.39	-.73	3.93	-.41	2.87	-1.74
BUTTE FAA AP	.14	-.41	.16	-.22	.91	.26	.57	-.41	.98	-.75	1.75	-.62
CARDWELL	.10		.10		1.39		.49		.94		3.64	
DILLON AIRPORT	.06	-.24	.02	-.23	.47	-.05	.44	-.52	.33	-1.26	3.33	1.36

SEE REFERENCE NOTES FOLLOWING STATION INDEX

TOTAL PRECIPITATION AND DEPARTURES FROM NORMAL (INCHES)

STATION	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL

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TOTAL PRECIPITATION AND DEPARTURES FROM NORMAL (INCHES)

MONTANA
1983

STATION	JUL		AUG		SEP		OCT		NOV		DEC		ANNUAL	
	PRECIP	DEPARTURE	PRECIP	DEPARTURE	PRECIP	DEPARTURE	PRECIP	DEPARTURE	PRECIP.	DEPARTURE	PRECIP.	DEPARTURE	PRECIP.	DEPARTURE
MONTANA														
WESTERN 01														
ANACONDA	2.11		2.10		2.33		.66		1.01		.65		14.34	
BIGFORK 13 S	3.04	1.72	.97	-.86	1.90	.13	1.26	-.34	2.68	.90	2.84	.69	25.82	3.74
CRESTON	3.66	2.31	1.16	-.59	1.70	.18	1.13	-.26	1.96	.55	2.57	.89	22.24	3.03
DARBY	2.29	1.51	2.07	1.11	2.31	1.09	.94	-.18	1.07	-.42	1.47	-.16	15.71	-.08
DRUMMOND AVIATION	2.47		1.76		2.00		.85		.62		1.19		15.16	
EUREKA RANGER STATION	2.33		1.36		.33		1.04		2.05		.98		17.26	
FORTINE 1 N	3.14	1.91	.95	-.62	.76	-.48	.90	-.30	1.82	.46	1.21	-.34	17.18	-.07
HAMILTON	2.15	1.37	1.71	.78	2.18	1.12	.54	-.43	1.04	-.06	1.03	-.16	14.29	1.18
HAUGAN 3 E	2.03	1.20	1.33	-.02	1.38	-.26	1.06	-1.28	4.62	1.05	3.42	-.92	28.22	-2.55
HERON 2 NW	4.19	3.26	1.96	.19	.95	-.91	1.47	-1.05	5.67	1.69	3.24	-1.59	35.86	1.65
HOT SPRINGS	1.27		.85		.86		.14		1.57		1.12		14.42	
HUNGRY HORSE DAM	5.54	3.93	.75	-1.45	3.56	1.00	2.54	-.46	6.33	2.77	2.33	-1.49	34.75	1.25
KALISPELL WSO AP R	2.06	1.12	.73	-.71	1.31	.20	.83	-.15	1.61	.32	1.69	.10	17.80	1.87
KILA 9 SSW	M		M		M									
LIBBY DAM	1.94		1.05		.81		.34		2.54		.80		15.00	
LIBBY 1 NE RANGER STN	2.02	1.23	.59	-.48	.88	-.31	.51	-.97	3.28	1.11	1.43	-1.04	17.50	-1.16
LIBBY 32 SSE	2.23		1.21		1.09		.69		3.75		1.63		22.10	
LINDBERGH LAKE	2.47		1.15		1.37		.99		3.29		3.05		23.93	
MISSOULA 2 NE	3.86		1.37		1.67		.55		1.80		2.01		21.66	
MISSOULA WSO AP //R	2.44	1.59	1.27	.32	1.37	.35	.37	-.48	1.17	.29	1.79	.58	16.71	3.42
OLNEY	3.14		1.78		1.12		1.03		3.64		.90		26.80	
OVANDO 9 SSE	3.33		1.97		1.43		.73		.75		1.52		15.29	
PHILIPSBURG RANGER STN	3.11	1.96	2.58	1.20	2.10	.82	1.40	.37	1.05	.31	.49	-.21	16.55	2.33
POLEBRIDGE	3.05	1.84	1.06	-.43	1.15	-.27	.56	-1.16	2.74	.44	1.72	-1.22	20.06	-3.28
POLSON	2.06		.92		1.39		.53		1.97		1.66		17.44	
POLSON KERR DAM	2.20	1.14	.71	-.45	1.23	.01	.47	-.50	1.78	.74	1.25	.06	17.19	2.21
POTOMAC	2.34		1.02		1.93		.59		1.35		1.69		15.83	
SAINT IGNATIUS	3.71	2.67	1.06	-.17	1.45	.11	1.05	-.08	1.10	.14	1.51	.42	19.50	3.32
SAINT REGIS RANGER STA	1.65		.56		M		1.26		1.75		.71			
SEELEY LAKE RANGER STA	3.57	2.61	1.32	.15	1.58	.24	1.39	.08	2.24	.14	2.81	-.18	22.27	.16
SILVER LAKE	2.88	1.55	3.07	1.80	1.63	.10								
STEVENSVILLE	2.25	1.47	3.74	2.95	1.46	.57	.59	-.22	1.07	.10	1.57	.32	15.42	2.93
SULA 3 ENE	2.98		2.29		1.98		1.44		1.14		1.14		17.54	
SUPERIOR	1.55	.70	1.10	-.10	1.51	.35	.62	-.65	1.84	.34	1.07	-.73	15.93	-1.53
SWAN LAKE	1.84		.76		M		1.64		M		2.01			
THOMPSON FALLS P H	1.78	.92	1.21	-.09	1.03	-.30	1.09	-.65	2.37	-.06	1.99	-.87	22.28	-.49
TROUT CREEK RANGER STA	3.42	2.46	1.28	-.12	.81	-.67	.81	-1.26	4.99	1.42	2.84	-1.50	29.95	-.54
TROY	2.72		2.06		.94		.98		5.51		M			
TROY 18 N	4.91		1.70		.89		3.10		7.63		3.36		41.63	
WESTERN MONTANA BR STN	2.44		1.62		1.94		.51		.71		.64		12.25	
WEST GLACIER	4.70	3.09	.52	-1.35	1.41	-.73	1.56	-.62	3.80	.82	2.72	-.82	29.18	-.74
WHITEFISH 5 NW	M													
--DIVISIONAL DATA-------->	2.75	1.69	1.37	.05	1.48	.10	.96	-.49	2.47	.60	1.75	-.44	20.68	.66
SOUTHWESTERN 02														
ALDER 17 S	2.71		2.33		1.95		1.35		M 1.40		.79		M 16.79	
ALDER RUBY DAM	2.09		2.87		2.08		2.38		2.81		1.77		22.27	
BELGRADE AIRPORT	2.41	1.37	1.01	-.17	3.17	1.83	1.57	.41	1.64	.94	1.10	.53	18.27	4.44
BOZEMAN MT ST UNIV	2.59	1.31	1.43	-.01	2.71	.89	2.10	.47	2.17	1.06	1.36	.60	21.76	3.13
BOZEMAN 6 W EXP FARM	2.58		2.07		2.66		2.05		2.10		1.00		20.11	
BOZEMAN 12 NE	6.10	4.20	2.20	-.12	5.17	2.21	1.94	-.78	3.04	.53	2.27	-.32	35.68	.87
BUTTE FAA AP	2.95	1.84	2.40	1.13	1.21	.09	.59	-.09	.33	-.12	.56	.12	12.55	.82
CARDWELL	2.75		1.45		2.09		1.85		.66		.52		15.98	
DILLON AIRPORT	2.15	1.26	2.42	1.58	1.42	.49	1.45	.87	.72	.29	.35	.08	13.16	3.63

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AVERAGE TEMPERATURES AND DEPARTURES FROM NORMAL (°F)

MONTANA
1983

STATION	JAN.		FEB		MAR		APR		MAY		JUN		JUL		AUG		SEP		OCT		NOV		DEC		ANNUAL	
	TEMPERATURE	DEPARTURE	TEMPERATURE	DEPARTURE	TEMPERATURE	DEPARTURE	TEMPERATURE	DEPARTURE	TEMPERATURE	DEPARTURE	TEMPERATURE	DEPARTURE	TEMPERATURE	DEPARTURE	TEMPERATURE	DEPARTURE	TEMPERATURE	DEPARTURE	TEMPERATURE	DEPARTURE	TEMPERATURE	DEPARTURE	TEMPERATURE	DEPARTURE	TEMPERATURE	DEPARTURE
MONTANA																										
WESTERN 01																										
ANACONDA	30.0		32.0		34.7		38.8		48.4		56.6		61.4		67.9		51.1		44.8		31.5		9.2		42.2	
BIGFORK 13 S	34.3	8.5	35.7	4.7	M39.3	4.0	43.9	-.2	53.2	.9	58.5	-.6	60.7	-5.8	66.7	1.8	53.1	-2.6	M47.2	1.5	38.6	3.5	18.7	-11.4	M45.8	.3
CRESTON	30.3	8.5	33.7	5.6	38.0	5.0	42.4	-.6	52.0	.4	57.4	-1.1	59.6	-4.7	65.5	2.7	50.3	-3.4	42.9	-.6	36.5	4.1	11.2	-15.2	43.3	.1
DARBY	32.5	6.6	35.9	3.8	40.5	4.7	42.4	-1.4	52.3	.2	59.6	.7	62.9	-2.6	69.4	5.4	52.7	-3.1	46.9	.2	35.8	1.0	13.1	-16.1	45.3	-.1
DRUMMOND AVIATION	28.4		33.4		38.4		41.5		50.4		59.3		63.1		68.6		51.6		43.9		33.2		6.5		43.2	
EUREKA RANGER STATION	31.4		35.2		40.3		44.8		55.6		58.1		62.8		66.9		52.1		44.7		36.5		10.0		44.9	
FORTINE 1 N	29.8	10.0	33.9	5.9	38.3	4.9	42.3	-.1	52.7	1.8	58.6	.9	61.0	-2.8	66.6	4.5	51.3	-2.5	44.5	1.3	35.8	5.1	9.8	-14.5	43.7	1.2
HAMILTON	31.2	6.2	35.1	3.3	39.6	3.3	43.9	-1.0	53.3	.2	60.3	.2	63.1	-3.9	68.6	3.5	52.7	-3.6	46.4	.5	37.7	3.6	13.5	-14.8	45.5	-.2
HAUGAN 3 E	28.8	6.3	33.5	4.1	38.7	5.8	41.8	0	49.7	-.7	57.5	.2	61.2	-1.9	66.6	4.9	51.0	-3.2	43.0	-1.3	M35.4	3.2	14.6	-11.3	M43.5	.5
HERON 2 NW	31.1	6.7	34.1	4.1	40.3	6.2	43.5	-.1	53.1	1.1	57.6	.6	60.9	-2.9	65.0	2.8	50.8	-3.6	44.2	-.1	37.1	3.4	18.3	-9.6	44.7	.6
HOT SPRINGS	34.3		37.4		40.8		45.3		54.0		60.5		64.3		69.6		54.2		46.0		36.6		13.0		46.3	
HUNGRY HORSE DAM	30.5	9.0	33.0	5.5	36.4	4.6	43.1	1.9	53.0	1.9	59.2	.9	61.6	-3.7	67.5	3.7	50.5	-3.4	42.4	-.6	35.6	3.9	12.6	-13.7	43.8	.8
KALISPELL WSO AP R	29.6	10.3	32.9	6.6	38.0	6.1	42.3	-.3	51.5	0	57.3	-1.0	61.2	-3.8	66.3	2.8	50.6	-3.3	42.8	.3	33.9	3.0	7.9	-16.3	42.9	.4
KILA 9 SSW	M		M		M		M		M		M		M		M		M									
LIBBY DAM	32.7		36.3		40.2		45.2		54.6		60.4		63.2		68.5		53.5		45.6		38.4		16.6		46.3	
LIBBY 1 NE RANGER STN	30.3	7.6	34.8	3.8	40.7	4.5	45.6	.6	54.6	.9	60.6	-.1	63.7	-3.0	69.2	3.8	54.1	-2.7	46.3	.9	38.3	5.2	15.1	-11.2	46.1	.9
LIBBY 32 SSE	26.3		30.1		34.5		39.4		47.9		53.5		56.9		61.5		46.4		40.1		31.6		8.0		39.7	
LINDBERGH LAKE	27.2		29.9		34.2		39.7		49.2		55.2		59.3		65.2		48.9		42.2		31.9		10.0		41.1	
MISSOULA 2 NE	31.2		35.3		40.7		43.5		52.1		58.4		62.0		69.4		51.2		45.3		35.4		12.8		44.8	
MISSOULA WSO AP //R	30.0	8.7	34.5	6.4	39.9	5.8	44.6	.7	51.8	-.3	58.6	-1.0	62.1	-5.1	68.9	3.4	51.1	-4.6	43.8	-.3	34.3	2.5	11.8	-13.1	44.3	.3
OLNEY	27.9		32.2		37.8		42.0		50.8		57.2		61.2		65.2		49.4		42.7		34.5		9.1		42.5	
OVANDO 9 SSE	23.0		26.0		33.6		37.1		46.7		54.5		57.5		62.9		46.6		38.4		29.9		3.6		38.3	
PHILIPSBURG RANGER STN	28.8	7.5	31.2	4.7	34.8	5.1	36.5	-2.1	46.0	-1.0	53.8	-.6	58.4	-2.9	64.0	4.2	49.3	-2.4	44.1	1.1	33.3	2.4	M 9.6	-15.7	M40.8	.0
POLEBRIDGE	24.7	7.6	30.0	5.5	33.7	4.7	38.8	.1	47.1	-.7	53.7	-1.0	56.6	-3.9	61.5	2.4	46.5	-4.2	39.7	-.6	32.8	4.3	4.9	-16.5	39.2	-.2
POLSON	33.6		37.2		40.2		46.0		55.6		60.6		63.2		69.5		54.1		48.4		38.8		16.6		47.0	
POLSON KERR DAM	33.9	9.4	37.7	7.1	41.1	5.8	45.4	.7	54.6	1.9	60.5	.6	63.5	-3.6	70.2	3.9	55.1	-1.7	47.7	1.6	38.4	3.9	16.0	-12.7	47.0	1.4
POTOMAC	24.6		29.2		36.3		39.6		48.5		56.8		60.8		66.3		49.6		43.5		31.9		4.4		41.0	
SAINT IGNATIUS	33.4	8.9	37.7	6.8	40.8	5.0	44.8	-.3	53.6	.2	59.6	-.9	61.8	-5.3	67.5	1.7	52.8	-3.7	45.4	-.2	38.1	3.9	14.8	-13.9	45.9	.2
SAINT REGIS RANGER STA	31.1		34.5		39.7		44.5		51.3		58.8		M62.8		68.4		M		47.2		38.3		16.0		M	
SEELEY LAKE RANGER STA	25.6	6.2	29.8	3.4	36.0	5.7	39.3	-.5	46.8	-2.0	54.8	-1.3	58.9	-3.5	64.5	3.4	48.8	-4.3	44.0	0	32.8	1.6	M10.3	-12.8	M41.0	-.3
STEVENSVILLE	31.3	7.8	34.8	4.3	40.7	5.0	42.6	-1.8	52.8	.3	60.7	1.1	62.8	-2.9	67.9	4.1	52.0	-3.1	44.8	.3	36.1	3.2	11.7	-15.1	44.9	.3
SULA 3 ENE	30.5		33.0		36.7		38.6		47.3		55.3		59.6		64.9		49.7		44.0		33.3		9.0		41.8	
SUPERIOR	32.7	7.3	36.4	4.0	41.5	4.2	44.8	-.8	53.8	0	60.6	.2	64.4	-3.1	70.6	4.8	53.9	-3.8	47.0	.4	38.9	4.4	17.3	-11.0	46.8	.5
SWAN LAKE	27.5		31.9		36.7		42.7		51.1		56.1		60.1		M63.1		M		43.3		M		11.5		M	
THOMPSON FALLS P H	33.2	6.8	37.3	4.1	42.6	4.7	46.4	-.3	55.4	.5	62.0	.4	64.9	-3.3	70.9	3.9	56.0	-2.8	47.7	-.1	38.9	3.3	18.8	-10.9	47.8	.5
TROUT CREEK RANGER STA	31.5	7.4	35.3	4.7	41.8	6.6	45.3	1.4	53.5	1.5	58.7	0	61.6	-3.4	66.4	2.2	53.7	-2.8	45.4	.0	37.8	4.2	17.9	-9.9	45.7	1.0
TROY	31.5		35.2		41.3		46.6		54.6		60.0		62.3		67.3		53.0		45.1		38.2		17.7		46.1	
TROY 18 N	30.2		34.0		37.7		44.6		53.2		58.1		61.7		66.7		51.8		44.6		35.4		15.2		44.4	
WESTERN MONTANA BR STN	32.6		35.6		41.0		43.6		52.2		60.1		63.3		68.2		52.9		45.8		36.3		12.4		45.3	
WEST GLACIER	28.7	8.1	32.2	5.4	36.5	5.2	41.3	.7	51.6	1.5	57.2	.1	60.5	-2.6	65.2	3.5	50.6	-2.0	43.3	1.0	34.6	3.7	11.5	-13.4	42.8	.9
--DIVISIONAL DATA ------>	30.1	8.4	33.8	5.4	38.6	5.7	42.7	.5	51.7	.1	58.0	.2	61.4	-3.0	66.8	3.9	51.3	-2.9	44.4	.6	35.4	3.5	12.2	-13.4	43.9	.8
SOUTHWESTERN 02																										
ALDER 17 S	27.9		28.7		33.3		34.8		45.0		53.8		60.1		64.9		50.7		44.2		M29.8		9.5		M40.2	
BELGRADE AIRPORT	28.4	12.2	32.5	9.0	37.3	9.0	38.9	-1.8	49.0	-1.6	58.1	.6	65.0	-1.9	69.8	4.8	53.1	-1.5	45.8	1.6	32.8	2.9	4.8	16.9	43.0	1.3
BOZEMAN MT ST UNIV	32.6	11.4	34.0	6.6	38.2	7.2	40.6	-1.0	49.9	1.2	58.9	.2	65.9	-1.1	69.5	4.2	54.5	-1.4	47.6	1.5	34.5	2.1	10.2	-15.6	44.7	1.0
BOZEMAN 6 W EXP FARM	31.7		33.0		37.5		38.6		48.3		57.1		63.8		67.1		53.2		45.7		33.5		8.2		43.1	
BOZEMAN 12 NE	27.6	8.6	26.7	3.0	31.3	5.4	33.7	-1.2	41.6	-2.5	50.6	-1.0	57.0	-1.2	60.5	3.6	46.5	-2.2	42.2	1.7	27.2	-1.5	7.2	-15.6	37.7	.2
BUTTE FAA AP	22.8	7.3	25.7	4.2	32.2	5.9	35.4	-2.0	M45.2	-2.1	53.4	-1.9	61.2	1.8	66.8	6.0	50.4	-.7	45.0	4.0	31.6	4.1	4.0	-15.6	M39.5	.6
CARDWELL	33.5		34.7		39.1		41.5		51.9		59.6		65.4		68.4		53.9		47.2		35.2		10.7		45.1	
DILLON AIRPORT	29.8	9.7	32.4	6.3	35.7	5.5	38.3	-2.2	47.8	-2.5	56.6	-1.8	M62.2	-4.0	66.0	1.7	52.2	-2.6	46.3	1.5	32.6	1.4	9.3	-14.7	M42.4	-.1
DILLON WMCE	30.5	8.1	33.4	5.0	36.8	4.6	40.2	-1.6	50.0	-.8	57.4	-1.1	63.5	-1.9	66.0	2.6	53.8	-1.3	47.0	.6	33.3	.4	11.3	-14.7	43.6	0
ENNIS	31.7	9.0	33.8	5.6	37.2	5.2	38.3	-3.1	48.8	-1.8	56.9	-1.3	63.6	1.6	67.4	4.1	53.9	.5	47.7	2.0	34.4	1.2	13.4	-13.2	43.9	.5
GALLATIN GATEWAY 26SSW	23.8		23.9		29.5		30.5		41.8		49.7		57.2		61.3		48.7		42.9		26.5		7.8		37.0	
GLEN 4 N	29.1		31.0		35.9		39.4		49.9		M		62.5		65.1		52.6		45.7		33.2		10.8		M	

SEE REFERENCE NOTES FOLLOWING STATION INDEX

AVERAGE TEMPERATURES AND DEPARTURES FROM NORMAL (F)

MONTANA
1983

JAN. FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC ANNUAL

SEE REFERENCE NOTES FOLLOWING STATION INDEX

TEMPERATURE EXTREMES AND FREEZE DATA (°F)

209-9

STATION	HIGHEST	DATE	LOWEST	DATE	LAST SPRING MINIMUM OF										FIRST FALL MINIMUM OF										NUMBER OF DAYS BETWEEN DATES				
					16° OR BELOW		20° OR BELOW		24° OR BELOW		28° OR BELOW		32° OR BELOW		32° OR BELOW		28° OR BELOW		24° OR BELOW		20° OR BELOW		16° OR BELOW		16° OR BELOW	20° OR BELOW	24° OR BELOW	28° OR BELOW	32° OR BELOW
					DATE	TEMP	DATE	TEMP	DATE	TEMP	DATE	TEMP	DATE	TEMP	DATE	TEMP.	DATE	TEMP.	DATE	TEMP.	DATE	TEMP.	DATE	TEMP					
MONTANA																													
WESTERN 01																													
ANACONDA	98	8/ 6	-38	12/24	4/14	14	4/14	14	5/13	21	5/14	26	5/16	31	9/10	29	9/19	23	9/19	23	9/20	13	9/20	13	159	159	129	120	117
BIGFORK 13 S	92	8/ 5	-10	12/24	NONE		2/ 7	20	3/20	23	4/14	26	5/13	30	9/20	30	10/29	26	11/29	21	11/30	17	[illegible]	14		296	254	190	130
CRESTON	97	8/ 8	-29	12/25	3/19	14	4/14	20	4/14	20	5/13	26	5/15	31	9/ 6	31	9/20	25	11/22	21	11/29	17	11/30	4	256	229	222	130	114
DARBY	99	8/ 6	-34	12/24	4/11	16	4/14	19	4/16	21	5/14	26	5/16	32	9/10	26	9/10	26	9/20	22	11/22	13	11/22	13	225	222	157	119	117
DRUMMOND AVIATION	101	8/ 6	-43	12/23	4/14	11	5/13	20	5/14	22	5/14	22	5/14	22	9/ 6	31	9/10	28	9/20	15	9/20	15	9/20	15	159	130	129	119	115
EUREKA RANGER STATION	95	8/ 8	-30	12/24	3/19	14	3/19	14	4/14	21	5/12	28	5/13	29	9/ 6	32	9/19	26	9/29	22	11/29	18	11/30	5	256	255	168	130	116
FORTINE 1 N	97	8/ 7	-32	12/24	3/19	10	4/14	17	5/12	24	5/13	27	5/31	32	9/ 6	30	9/19	28	9/20	24	9/29	20	11/29	13	255	168	131	129	98
HAMILTON	98	8/ 5	-30	12/23	4/13	15	4/13	15	4/14	21	5/13	26	5/14	32	9/14	32	9/20	23	9/20	23	11/ 9	20	11/22	15	223	210	159	130	123
HAUGAN 3 E	98	8/ 7	-34	12/23	4/14	15	5/13	20	5/14	23	5/14	23	6/26	30	9/ 6	29	9/20	24	9/20	24	9/29	20	11/28	8	228	139	129	129	72
HERON 2 NW	91	5/29	-14	12/23	2/ 5	12	4/14	20	5/12	24	5/14	28	5/19	31	9/19	24	9/19	24	9/19	24	11/29	17	11/30	16	298	229	130	128	123
HOT SPRINGS	100	8/ 7	-31	12/23	2/ 7	16	4/14	19	4/14	19	5/14	28	5/19	31	9/ 6	32	9/10	28	9/20	20	9/20	20	11/22	16	288	159	159	119	110
HUNGRY HORSE DAM	96	8/ 7	-16	12/24	3/21	15	3/21	15	3/21	15	5/12	28	5/13	30	9/12	32	9/20	26	11/21	22	11/22	19	11/29	10	253	246	245	131	122
KALISPELL WSO AP R	96	8/ 7	-30	12/24	2/ 8	12	4/14	17	5/13	24	5/14	28	6/21	32	9/ 6	30	9/10	28	9/19	23	10/24	20	11/22	15	287	193	129	119	77
KILA 9 SSW					NONE		NONE		NONE		NONE		NONE		NONE		NONE		NONE		NONE		NONE						
LIBBY DAM	99	8/ 7	-18	12/24	2/ 5	16	3/19	20	4/13	24	4/30	28	5/13	30	9/ 6	30	9/20	28	10/24	22	11/30	13	11/30	13	298	256	194	143	116
LIBBY 1 NE RANGER STN	99	8/ 8	-26	12/24	2/ 5	11	3/19	18	4/15	24	5/14	28	5/14	28	9/ 6	30	9/20	26	10/ 8	24	11/30	11	11/30	11	298	256	176	129	115
LIBBY 32 SSE	93	8/ 7	-38	12/24	4/15	15	5/13	19	5/14	22	6/21	27	6/26	30	7/ 4	31	9/ 6	25	9/10	20	9/10	20	9/20	16	158	120	119	77	8
LINDBERGH LAKE	91	8/ 7	-35	12/24	3/20	12	4/14	20	4/14	20	5/14	28	5/14	28	9/ 6	31	9/10	28	9/20	20	9/20	20	11/22	10	247	159	159	119	115
MISSOULA 2 NE	98	8/ 7	-30	12/23	2/ 6	11	3/20	20	4/14	22	5/12	28	5/13	30	9/10	31	9/20	23	9/20	23	11/22	15	11/22	15	289	247	159	131	120
MISSOULA WSO AP //R	98	8/ 6	-30	12/23	2/ 6	9	3/21	20	4/14	21	5/13	28	5/14	30	9/10	28	9/10	28	9/20	24	11/22	16	11/22	16	289	246	159	120	119
OLNEY	98	8/ 7	-40	12/24	4/14	16	5/13	20	5/14	23	5/31	28	6/25	31	9/ 6	26	9/ 6	26	9/19	21	9/20	15	9/20	15	159	130	128	98	73
OVANDO 9 SSE	97	8/ 7	-45	12/23	4/14	9	5/13	18	5/14	21	5/14	21	6/25	31	7/ 4	30	9/ 6	26	9/10	21	9/20	13	9/20	13	159	130	119	115	9
PHILIPSBURG RANGER STN	97	8/ 7	-38	12/21	4/14	13	5/13	18	5/14	22	5/14	22	6/25	31	7/ 4	29	9/ 6	26	9/10	23	9/20	8	9/20	8	159	130	119	115	9
POLEBRIDGE	94	8/ 6	-41	12/25	4/14	14	5/13	17	5/19	24	6/21	28	6/26	32	7/27	32	9/ 6	25	9/19	23	9/20	13	9/20	13	159	130	123	77	31
POLSON	99	8/ 5	-23	12/24	1/ 1	11	3/19	19	3/20	22	4/14	26	5/13	31	9/20	23	9/20	23	9/20	23	11/29	20	11/30	12	333	255	184	159	130
POLSON KERR DAM	99	8/ 6	-22	12/24	2/ 5	16	3/20	20	4/14	24	4/14	24	5/14	32	9/20	25	9/20	25	11/22	22	11/30	13	11/30	13	298	255	222	159	129
POTOMAC	100	8/ 7	-50	12/24	4/14	11	5/13	19	5/14	21	5/31	26	6/26	32	7/ 4	32	9/ 6	26	9/10	22	9/28	20	10/24	16	193	138	119	98	8
SAINT IGNATIUS	99	8/ 6	-26	12/24	2/ 6	15	4/14	20	4/14	20	5/14	28	5/14	28	9/10	32	9/20	23	9/20	23	11/22	19	11/30	8	297	222	159	129	119
SAINT REGIS RANGER STA	101	8/ 8	-21	12/24	4/14	15	5/13	20	5/16	23	5/16	23	6/27	31	9/ 6	28	9/ 6	28	9/21	22	10/11	19	11/30	8	230	151	128	113	98
SEELEY LAKE RANGER STA	97	8/ 7	-43	12/24	4/14	16	5/16	20	5/16	20	5/16	20	6/14	32	9/ 5	32	9/ 6	28	9/18	24	9/22	20	11/21	16	221	129	125	113	83
STEVENSVILLE	94	8/ 8	-35	12/24	3/20	15	4/15	20	5/13	24	5/14	25	5/14	25	9/ 5	32	9/10	27	9/20	19	9/20	19	11/22	13	247	158	130	119	114
SULA 3 ENE	98	8/ 6	-45	12/23	5/14	15	5/14	15	5/14	15	6/25	27	6/25	27	7/ 4	25	7/ 4	25	9/10	21	9/20	13	9/20	13	129	129	119	9	9
SUPERIOR	98	8/ 8	-21	12/24	2/ 6	11	4/14	20	4/14	20	5/13	27	5/14	29	9/19	32	9/20	28	11/ 9	23	11/29	20	11/30	9	297	229	209	130	128
SWAN LAKE					3/21	13	4/14	17	5/13	21	5/14	26	5/20	31	10/ 1	32	10/ 2	28	10/ 8	21	12/ 1	5	12/ 1	5	255	231	148	141	134
THOMPSON FALLS P H	100	8/ 6	-17	12/23	2/ 6	16	2/ 6	16	4/17	24	5/13	28	5/14	30	9/19	31	9/20	25	11/22	23	11/29	20	11/30	12	297	296	219	130	128
TROUT CREEK RANGER STA	95	8/ 7	-22	12/23	2/ 6	6	4/13	19	5/13	24	5/14	25	6/21	31	7/15	32	9/19	27	9/20	23	11/22	18	11/29	16	296	223	130	128	24
TROY	96	8/ 7	-16	12/23	2/ 6	10	2/ 6	10	4/13	24	5/13	28	5/19	32	9/ 6	32	9/19	27	9/20	23	11/30	12	11/30	12	297	297	160	129	110
TROY 18 N	94	8/ 8	-17	12/22	2/ 6	5	2/ 6	5	4/14	23	5/13	27	5/19	29	9/19	24	9/19	24	9/19	24	11/29	18	11/30	8	297	296	158	129	123
WESTERN MONTANA BR STN	95	8/ 7	-32	12/23	4/14	13	4/14	13	5/14	23	5/14	23	5/14	23	9/10	30	9/20	19	9/20	19	9/20	19	11/22	12	222	159	129	129	119
WEST GLACIER	90	7/20	-25	12/24	3/20	16	4/17	20	4/17	20	5/14	27	6/21	32	9/ 6	32	9/20	22	9/20	22	11/22	18	11/30	5	255	219	156	129	77
SOUTHWESTERN 02																													
ALDER 17 S	94	8/ 7	-41	12/23	5/13	16	5/14	19	5/14	19	5/17	26	6/22	32	7/ 4	32	9/10	25	9/19	23	9/20	8	9/20	8	130	129	128	116	12
BELGRADE AIRPORT	100	8/ 6	-46	12/24	4/14	14	5/13	20	5/14	24	5/14	24	5/31	32	9/10	32	9/19	27	9/20	20	9/20	20	11/22	9	222	130	129	128	102
BOZEMAN MT ST UNIV	97	8/ 6	-32	12/24	4/14	16	5/13	20	5/13	20	5/14	27	5/14	27	9/19	26	9/19	26	9/20	16	9/20	16	9/20	16	159	130	130	128	128
BOZEMAN 6 W EXP FARM	95	8/ 7	-39	12/24	5/13	16	5/13	16	5/14	23	5/15	28	6/ 1	32	9/10	30	9/19	26	9/20	18	9/20	18	11/23	5	194	130	129	127	101
BOZEMAN 12 NE	91	8/ 7	-47	12/24	5/15	15	5/15	15	5/15	15	6/15	28	6/22	31	7/ 4	30	9/ 6	26	9/10	23	9/19	20	9/20	6	128	127	118	83	12
BUTTE FAA AP	97	8/ 6	-52	12/23	4/14	11	5/14	18	5/14	18	5/14	18	6/22	32	7/ 4	31	9/19	16	9/19	16	9/19	16	9/19	16	158	128	128	128	12
CARDWELL	101	8/ 6	-35	12/24	4/14	11	5/13	20	5/14	21	5/14	21	5/15	29	9/19	28	9/19	28	9/20	14	9/20	14	9/20	14	159	130	129	128	127
DILLON AIRPORT	94	8/ 5	-37	12/24	4/14	13	5/14	20	5/14	20	5/14	20	5/31	30	9/10	29	9/19	16	9/19	16	9/19	16	9/19	16	158	128	128	128	102
DILLON WMCE	95	8/ 7	-35	12/24	4/14	15	5/14	20	5/14	20	5/17	28	5/31	30	9/10	28	9/10	28	9/19	24	9/20	12	9/20	12	159	129	128	116	102
ENNIS	95	8/ 7	-30	12/24	4/14	13	5/14	20	5/14	20	5/31	28	6/ 1	32	9/10	28	9/10	28	9/20	12	9/20	12	9/20	12	159	129	129	102	101
GALLATIN GATEWAY 26SSW	90	8/ 7	-41	12/24	5/14	12	5/14	12	5/31	22	6/ 2	26	6/28	30	7/ 3	28	7/ 3	28	9/19	23	9/20	5	9/20	5	129	129	111	31	5
GLEN 4 N	97	8/ 6	-37	12/24	4/14	15	4/27	20	5/14	21	5/14	23	6/17	32	9/10	30	9/19	24	9/19	24	9/20	15	9/20	15	159	146	128	128	85
HEBGEN DAM	87	8/11	-33	12/22	4/26	14	5/10	20	5/15	24	5/31	28	6/14	30	9/ 6	32	9/19	26	9/20	12	9/20	12	9/20	12	147	133	128	111	84

SEE REFERENCE NOTES FOLLOWING STATION INDEX

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12/23 | 4/29 12 | 4/30 20 | 5/14 24 | 6/ 6 28 | 6/15 31 | 9/13 32 | 9/20 25 | 9/21 23 | 9/22 20 | 11/ 9 | 11 194 146 131 129 100
                                                 9/13 26 | 9/13 26 | 9/22 21 | 10/ 8 20 | 11/ 9 | 15 194 161 131        0
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MONTHLY AND SEASONAL COOLING DEGREE DAYS
BASE 65 DEGREES FAHRENHEIT

209-10

STATION	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL	[illegible]
MONTANA														
WESTERN														
ANACONDA	0	0	0	0	0	3	46	116	11	0	0	0	176	
BIGFORK 13 S	0	0	B 0	0	9	2	3	81	4	B 0	0	0	B 99	238
CRESTON	0	0	0	0	7	6	8	74	6	0	0	0	101	128
DARBY	0	0	0	0	9	12	49	157	4	0	0	0	231	172
DRUMMOND AVIATION	0	0	0	0	0	10	53	127	8	0	0	0	198	
EUREKA RANGER STATION	0	0	0	0	12	5	33	114	1	0	0	0	165	
FORTINE 1 N	0	0	0	0	6	6	9	98	0	0	0	0	119	135
HAMILTON	0	0	0	0	12	8	47	127	5	0	0	0	199	217
HAUGAN 3 E	0	0	0	0	0	0	25	93	5	0	B 0	0	B 123	80
HERON 2 NW	0	0	0	0	3	4	12	55	0	0	0	0	74	113
HOT SPRINGS	0	0	0	0	0	8	55	160	7	0	0	0	230	
HUNGRY HORSE DAM	0	0	0	0	15	5	42	111	7	0	0	0	180	201
KALISPELL WSO AP R	0	0	0	0	4	4	17	83	4	0	0	0	112	177
KILA 9 SSW	-	-	-	-	-	-	-	-	-	-	-	-	-	
LIBBY DAM	0	0	0	0	14	14	41	138	1	0	0	0	208	
LIBBY 1 NE RANGER STN	0	0	0	0	8	28	49	146	7	0	0	0	238	225
LIBBY 32 SSE	0	0	0	0	0	0	1	27	0	0	0	0	28	
LINDBERGH LAKE	0	0	0	0	0	0	17	73	3	0	0	0	93	
MISSOULA 2 NE	0	0	0	0	7	3	49	152	5	0	0	0	216	
MISSOULA WSO AP / / R	0	0	0	0	0	4	43	138	5	0	0	0	190	216
OLNEY	0	0	0	0	0	11	24	81	5	0	0	0	121	
OVANDO 9 SSE	0	0	0	0	0	4	11	47	3	0	0	0	65	
PHILIPSBURG RANGER STN	0	0	0	0	0	2	8	58	4	0	0	B 0	B 72	45
POLEBRIDGE	0	0	0	0	0	0	5	29	0	0	0	0	34	35
POLSON	0	0	0	0	21	9	32	149	3	0	0	0	214	
POLSON KERR DAM	0	0	0	0	14	12	37	168	8	0	0	0	239	259
POTOMAC	0	0	0	0	0	0	23	91	4	0	0	0	118	
SAINT IGNATIUS	0	0	0	0	2	8	24	112	5	0	0	0	151	239
SAINT REGIS RANGER STA	0	0	0	0	0	13	B 35	138	-	0	0	0	-	
SEELEY LAKE RANGER STA	0	0	0	0	0	1	12	57	6	0	0	B 0	B 76	65
STEVENSVILLE	0	0	0	0	1	11	45	113	8	0	0	0	178	146
SULA 3 ENE	0	0	0	0	0	1	15	64	2	0	0	0	82	
SUPERIOR	0	0	0	0	8	13	74	185	11	0	0	0	291	265
SWAN LAKE	0	0	0	0	3	0	6	B 39	-	0	-	0	-	
THOMPSON FALLS P H	0	0	0	0	19	29	71	195	9	0	0	0	323	317
TROUT CREEK RANGER STA	0	0	0	0	2	8	29	77	6	0	0	0	122	174
TROY	0	0	0	0	11	17	31	99	3	0	0	0	161	
TROY 18 N	0	0	0	0	7	5	31	87	3	0	0	0	133	
WESTERN MONTANA BR STN	0	0	0	0	1	8	55	120	4	0	0	0	188	
WEST GLACIER	0	0	0	0	6	1	22	69	0	0	0	0	98	91
SOUTHWESTERN 02														
ALDER 17 S	0	0	0	0	0	0	17	70	5	0	B 0	0	B 92	
BELGRADE AIRPORT	0	0	0	0	0	6	92	157	17	0	0	0	272	225
BOZEMAN MT ST UNIV	0	0	0	0	4	12	115	155	19	0	0	0	305	241
BOZEMAN 6 W EXP FARM	0	0	0	0	0	6	68	96	16	0	0	0	186	
BOZEMAN 12 NE	0	0	0	0	0	0	1	12	0	0	0	0	13	16
BUTTE FAA AP	0	0	0	0	B 0	2	40	87	6	0	0	0	B 135	107
CARDWELL	0	0	0	0	2	6	92	121	13	0	0	0	234	
DILLON AIRPORT	0	0	0	0	0	3	B 33	78	9	0	0	0	B 123	219
DILLON WMCE	0	0	0	0	1	0	49	80	4	0	0	0	134	145
ENNIS	0	0	0	0	0	3	54	91	14	0	0	0	162	128
GALLATIN GATEWAY 26SSW	0	0	0	0	0	0	0	18	0	0	0	0	18	
GLEN 4 N	0	0	0	0	3	-	37	53	1	0	0	0	-	
HEBGEN DAM	0	0	0	0	0	0	3	22	0	0	0	0	25	23
LAKEVIEW	B 0	B 0	B 0	0	0	B 0	0	B 8	0	0	0	0	B 8	8
LIMA	0	0	0	0	0	1	24	53	8	0	0	0	86	56
MOULTON RESERVOIR	0	0	0	0	0	0	0	8	0	0	0	0	8	
NORRIS MADISON P H	0	0	0	0	5	8	130	206	30	0	0	0	379	415

SOIL TEMPERATURES

MONTANA
1983

209-11

STATION	DEPTH	TIME	JAN AVERAGE	JAN EXTREMES	FEB AVERAGE	FEB EXTREMES	MAR AVERAGE	MAR EXTREMES	APR AVERAGE	APR EXTREMES	MAY AVERAGE	MAY EXTREMES	JUN AVERAGE	JUN EXTREMES	JUL AVERAGE	JUL EXTREMES	AUG AVERAGE	AUG EXTREMES	SEP AVERAGE	SEP EXTREMES	OCT AVERAGE	OCT EXTREMES	NOV AVERAGE	NOV EXTREMES	DEC AVERAGE	DEC EXTREMES	ANNUAL AVERAGE	ANNUAL EXTREMES
MONTANA																												
WESTERN 01																												
CRESTON	(IN)																											
	4	MAX		-		-		-		-		-		-	78.5	96	90.2	102	68.3	95	54.5	64	41.6	53	30.0	33	-	-
	4	MAX		-		-		-		-		-		-		57		73		54		41		33		24		-
	4	MIN	-	-	-	-				-		-	-	-	59.0	66	65.4	73	49.1	63	40.3	48	33.0	42	28.5	33	-	-
	4	MIN		-		-		-		-		-		-		52		55		38		32		26		23		-
	8	MAX	34.1	35	34.5	40	42.7	45	50.7	62	60.5	76	69.3	74	69.2	75	76.0	82	61.8	74	50.9	56	42.8	50	35.0	39	52.3	82
	8	MAX		33		33		40		44		52		63		63		70		54		47		37		31		31
	8	MIN	33.1	34	33.6	39	41.9	45	48.4	59	57.8	72	66.5	73	65.5	71	73.1	80	59.2	72	49.6	56	40.9	48	34.2	36	50.3	80
	8	MIN		31		33		40		41		49		61		59		67		52		44		35		31		31
WESTERN MONTANA BR STN	(IN)																											
	2	MAX	33.4	40	39.2	52	52.7	59	63.1	76	72.4	88	85.5	91	82.6	93	89.8	99	69.1	80	56.2	62	42.1	56	28.3	32	59.5	99
	2	MAX		30		31		43		49		52		72		65		84		52		52		32		21		21
	2	MIN	30.9	34	32.6	39	38.1	44	42.3	56	50.6	60	62.6	69	61.4	68	66.2	78	50.3	62	41.8	49	37.2	46	26.6	32	45.1	78
	2	MIN		23		23		32		34		40		52		51		60		38		37		29		20		20
	4	MAX	36.4	40	40.4	50	51.7	56	60.0	72	68.9	84	82.3	91	79.5	88	84.8	93	67.6	77	55.9	61	45.4	56	33.4	37	58.9	93
	4	MAX		35		31		45		50		55		74		69		69		56		50		37		28		28
	4	MIN	35.4	38	36.9	43	44.1	48	49.8	61	57.5	67	69.1	75	68.1	75	72.9	82	58.3	69	48.8	54	42.3	51	32.4	36	51.3	82
	4	MIN		30		31		39		40		48		61		60		64		47		44		37		27		27
	8	MAX	35.2	37	37.4	45	46.4	50	53.3	63	61.6	74	73.6	79	72.0	80	77.8	85	63.2	72	52.2	56	43.6	52	33.1	38	54.1	85
	8	MAX		34		33		41		46		52		68		66		71		54		49		37		28		28
	8	MIN	34.6	36	35.7	41	43.4	47	48.8	59	56.3	66	67.9	72	67.3	78	72.5	80	58.5	68	48.7	53	42.3	50	32.3	36	50.7	80
	8	MIN		34		33		39		41		48		62		60		66		49		45		36		28		28
	20	5PM	34.9	36	35.3	39	42.0	44	47.1	53	54.2	63	65.0	67	65.3	69	70.8	74	61.1	68	51.3	56	44.8	50	35.4	40	50.6	74
	20	5PM		34		34		39		43		50		62		62		69		53		48		39		32		32
SOUTHWESTERN 02																												
BOZEMAN 6 W EXP FARM	(IN)																											
	2	MAX	29.8	31	30.2	32	38.1	44	45.3	58	58.5	73	70.8	77	76.3	83	77.0	84	63.1	76	48.8	53	38.4	48	30.8	32	50.6	84
	2	MAX		27		25		32		33		40		58		64		71		46		43		33		27		25
	2	MIN	27.6	30	28.0	31	32.9	36	37.1	46	46.2	57	56.7	69	60.7	66	62.5	70	50.8	62	41.7	47	36.2	44	27.9	32	42.4	70
	2	MIN		24		18		31		33		37		51		51		57		38		37		32		0		0
	4	MAX	30.1	32	30.8	33	37.7	42	44.4	56	56.0	69	67.4	72	72.3	77	73.2	79	60.9	72	47.9	52	39.5	48	32.2	33	49.4	79
	4	MAX		28		27		32		34		41		60		65		68		46		43		34		30		27
	4	MIN	29.1	31	29.6	32	34.5	38	39.3	48	48.9	60	59.1	65	63.7	68	65.6	71	54.1	65	44.5	49	38.0	46	29.3	33	44.6	71
	4	MIN		26		22		32		34		39		54		55		61		43		40		33		2		2
	8	MAX	30.7	32	29.9	31	33.9	37	40.2	49	50.2	60	61.0	65	66.3	70	68.5	73	57.9	67	46.6	50	39.9	46	32.7	35	46.5	73
	8	MAX		29		26		31		34		41		57		59		65		48		43		35		30		26
	8	MIN	29.8	31	28.6	30	33.0	36	38.6	47	47.9	59	59.0	64	64.2	68	66.8	70	55.8	65	45.2	49	39.0	45	30.2	35	44.8	70
	8	MIN		28		25		30		33		39		55		58		63		46		42		35		6		6
	20	5PM	33.9	35	33.0	33	34.8	37	39.2	44	46.8	54	56.1	59	61.1	64	64.3	66	57.9	63	48.8	52	42.4	47	36.2	38	46.2	66
	20	5PM		33		33		33		36		43		54		58		63		52		46		38		35		33
CENTRAL 04																												
MOCCASIN EXP STATION	(IN)																											
BARE GROUND																												
	4	MAX	33.1	36	35.8	46	44.0	55	54.3	66	61.9	81	76.3	88	82.8	95	87.3	98	69.4	90	54.5	62	42.8	55	35.0	38	56.4	98
	4	MAX		27		30		36		42		37		63		59		77		41		46		[illegible]		31		27
	4	MIN	30.2	35	32.4	36	36.9	44	40.5	48	47.3	60	57.4	65	61.1	69	65.4	74	51.2	69	42.4	47	38.4	46	34.5	37	44.8	74
	4	MIN		26		27		36		27		36		53		52		59		39		40		35		31		26
	8	MAX	32.5	36	32.9	38	40.0	48	47.9	56	55.1	70	67.4	76	73.5	80	77.4	86	63.0	80	49.7	54	41.7	51	34.9	38	51.3	86
	8	MAX		29		29		35		39		37		61		59		70		43		45		37		32		29
	8	MIN	31.5	35	32.0	35	37.3	44	42.4	49	48.6	62	59.2	65	64.2	70	68.4	75	54.9	71	45.0	50	39.7	48	34.2	37	46.5	75
	8	MIN		28		28		35		37		36		56		54		63		41		41		35		31		28
	20	8AM	34.3	36	32.8	33	37.1	45	41.5	46	46.6	56	55.7	59	60.6	64	65.0	68	58.3	65	49.5	52	44.1	48	37.8	40	46.9	68
	20	8AM		33		32		34		38		38		54		57		63		52		47		40		35		32
500	4	MAX	34.1	36	33.0	35	42.5	48	47.1	58	56.8	66	69.4	79	74.3	81	76.2	87	61.4	78	49.2	51	44.5	48	36.5	42	52.1	87
	4	MAX		34		32		36		43		48		62		66		69		47		48		41		27		27
	4	MIN	34.0	35	32.8	34	41.7	47	46.1	58	55.1	66	64.6	70	68.5	74	72.4	81	59.3	75	49.0	51	43.9	48	35.8	40	50.3	81
	4	MIN		33		31		33		42		47		61		61		68		47		48		39		26		26

SOILS REFERENCE NOTES

STATION NAME	SOIL TYPE	SOIL COVER	SLOPE	UNITS
BOZEMAN 6 W EXP FARM	BOZEMAN SILT LOAM	SOD	3% TO NW	F
~~CRESTON~~	~~CRESTON SILT LOAM~~	~~BARE~~	~~2% TO S~~	~~F~~
HUNTLEY EXP STATION	PRYOR SILTY CLAY	BARE	2% TO W	F
MOCCASIN EXP STATION	JUDITH CLAY LOAM	BARE, SOD	0-1% TO N	F
WESTERN MONTANA BR STA	BURNT FORK COBBLY LOAM	GRASS	2% TO S	F

205-12

TOTAL EVAPORATION AND WIND MOVEMENT

MONTANA
1983

STATION		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
MONTANA														
WESTERN 01														
HUNGRY HORSE DAM	WIND	-	-	-	-	B 1760	1159	B 1134	1238	922	-	-	-	-
	EVAP	-	-	-	-	-	4.93	B 5.34	B 6.17	B 2.75	-	-	-	-
	MAX TEMP	-	-	-	-	M -	M -	M -	M 77.6	M -	-	-	-	M -
	MIN TEMP	-	-	-	-	M -	M -	M -	M 53.3	M -	-	-	-	M -
WESTERN MONTANA BR STN	WIND	-	-	-	-	1397	948	B 1085	723	802	-	-	-	-
	EVAP	-	-	-	-	-	B 6.58	B 7.10	-	B 4.07	-	-	-	-
	MAX TEMP	-	-	-	-	M 65.7	M 76.4	M 80.8	M 87.5	M -	-		-	M -
	MIN TEMP	-	-	-	-	M 36.4	M 44.9	M 48.0	M 52.5	M -	-		-	M -
SOUTHWESTERN 02														
BOZEMAN 6 W EXP FARM	WIND	-	-	-	-	2063	1355	1658	967	1363	818	B 1389		-
	EVAP	-	-	-	-	B 5.97	B 6.17	8.16	B 6.53	4.38	B 2.31	-	-	-
	MAX TEMP	-	-	-	-	M 69.1	78.9	83.9	84.6	68.2	56.9	M -	-	M -
	MIN TEMP	-	-	-	-	M 41.9	49.1	52.6	55.1	45.1	38.5	M -	-	M -
DILLON WMCE	WIND	-	-	-	-	B 752	602	681	399	455	-	-	-	-
	EVAP	-	-	-	-	B 4.88	5.14	B 7.61	4.78	B 3.55	-	-	-	-
	MAX TEMP	-	-	-	-	M 71.6	79.4	82.9	83.8	68.8	-	-	-	M -
	MIN TEMP	-	-	-	-	M 43.0	49.9	53.5	56.3	45.0	-	-	-	M -
NORTH CENTRAL 03														
FORT ASSINNIBOINE	WIND	-	-	-	1264	1361	1046	1116	1012	1232	-	-	-	-
	EVAP	-	-	-	4.02	5.82	B 6.50	B 7.55	8.08	B 4.94	-	-	-	-
	MAX TEMP	-	-	-	64.3	75.4	M 83.1	M 87.9	88.6	69.2	-	-	-	M -
	MIN TEMP	-	-	-	39.1	46.2	M 54.8	M 58.4	59.8	46.7	-	-	-	M -
MALTA 7 E	WIND	-	-	-	-	B 1034	-	456	483	620	-	-	-	-
	EVAP	-	-	-	-	B 5.26	5.95	B 7.29	B 6.61	B 3.83	1.34	-	-	-
	MAX TEMP	-	-	-	M -	M 75.1	M 85.9	M -	-	-	-	-	-	M -
	MIN TEMP	-	-	-	M -	M 45.7	M 54.5	M -	-	-	-	-	-	M -
CENTRAL 04														
CANYON FERRY DAM	WIND	-	-	-	-	-	B 921	1078	735	990	-	-	-	-
	EVAP	-	-	-	-	-	B 5.79	B 6.41	6.02	3.99	-	-	-	-
	MAX TEMP	-	-	-	-	-	M 78.2	M 82.5	85.4	68.5	M -	-	-	M -
	MIN TEMP	-	-	-	-	-	M 54.5	58.1	61.9	47.9	M -	-	-	M -
MOCCASIN EXP STATION	WIND	-	-	-	2507	2559	2238	2227	2233	2352	2316	-	-	-
	EVAP	-	-	-	B 4.25	B 6.68	6.57	B 7.55	8.81	B 5.50	-	-	-	-
	MAX TEMP	-	-	-	M 56.1	M 66.4	73.5	78.3	79.4	M 65.7	M -	-	-	M -
	MIN TEMP	-	-	-	M 35.6	M 41.3	47.2	51.3	54.8	M 43.0	M -	-	-	M -
SOUTH CENTRAL 05														
HUNTLEY EXP STATION	WIND	-	-	-	B 2337	2838	1568	1583	1617	1761	-	-	-	-
	EVAP	-	-	-	B 5.22	B 7.18	7.37	B 9.15	9.23	B 6.02	-	-	-	-
	MAX TEMP	-	-	-	59.9	M 68.3	79.1	85.9	87.3	M 68.1	-	-	-	M -
	MIN TEMP	-	-	-	36.2	M 42.5	51.8	56.3	58.3	M 43.4	-	-	-	M -
YELLOWTAIL DAM	WIND	-	-	-	-	-	1178	1454	1220	1480	-	-	-	-
	EVAP	-	-	-	-	-	8.27	11.18	11.50	B 7.74	-	-	-	-
	MAX TEMP	-	-	-	-	-	M 82.4	M -	M -	M -	M -	-	-	M -
	MIN TEMP	-	-	-	-	-	M 51.6	M -	M -	M -	M -	-	-	M -
NORTHEASTERN 06														
SIDNEY	WIND'	-	-	-	1579	B 1333	1207	1274	-	1326	1037	1037	-	-
	EVAP	-	-	-	B 4.51	B 5.13	6.13	8.14	5.80	B 3.67	1.50	-	-	-
	MAX TEMP	-	-	-	58.9	71.7	84.0	91.3	88.4	66.3	52.4	M -	-	M -
	MIN TEMP	-	-	-	36.9	44.3	53.9	62.4	61.7	46.0	38.1	M -	-	M -

SEE REFERENCE NOTES FOLLOWING STATION INDEX

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STATION INDEX

MONTANA
1983

YEARS OF RECORD

OPENED OR CLOSED

SEE

							71	71			
HEBGEN DAM	4007	06	GARFIELD	48 33	109 46W	2584	22	22	0		C
HELENA WSO AP	//R 4038	02	GALLATIN	47 34	106 42W	2650	32	33	0		C H
HERON 2 NW	4055	04	LEWIS-CLARK	44 52	111 20W	6489	66	69	0		H
HIGHWOOD 7 NE	4084	01	SANDERS	46 36	112 0W	3893	104	104	0		C H
HINGHAM	4133	03	CHOUTEAU	48 5	116 0W	2240	63	71	0		C HJ
HINSDALE 4 SW	4172	03	HILL	47 39	110 40W	3600	0	74	0		H
	4180	06	VALLEY	48 33	110 26W	3030	0	30	0	OCT	H
				48 21	107 9W	2675	13	13	0	NOV	

STATION INDEX

1971

STATION	INDEX NO	DIVISION NO	COUNTY	LATITUDE	LONGITUDE	ELEVATION FEET	YEARS OF RECORD TEMP.	YEARS OF RECORD PRECIP.	YEARS OF RECORD EVAP.	OPENED OR CLOSED DURING YR MONTH OPENED	OPENED OR CLOSED DURING YR MONTH CLOSED	SEE REFERENCE NOTES
HOBSON	4193	04	JUDITH BASIN	47 0	109 52W	4080	0	36	0			
HOLTER DAM	4241	04	LEWIS-CLARK	47 0	112 1W	3487	73	80	0			C
HOT SPRINGS	4297	01	SANDERS	47 37	114 39W	2780	15	15	0			
HUNGRY HORSE DAM	4328	01	FLATHEAD	48 21	114 0W	3160	36	36	35			
HUNTLEY EXP STATION	4345	05	YELLOWSTONE	45 55	108 15W	2989	703	703	703			G
HYSHAM	4358	05	TREASURE	46 18	107 14W	2660	36	37	0			
HYSHAM 25 SSE	4364	05	TREASURE	45 54	107 8W	3100	23	24	0			H
ILIAD	4368	03	CHOUTEAU	47 48	109 47W	2950	24	24	0			C
INGOMAR 11 NE	4386	07	ROSEBUD	46 42	107 13W	2780	27	30	0			H
JOLIET	4506	05	CARBON	45 29	108 58W	3700	27	32	0			H
JOPLIN 1 N	4512	03	LIBERTY	48 35	110 47W	3360	37	50	0			C H
JORDAN	4522	06	GARFIELD	47 19	106 54W	2590	54	62	0			
JORDAN 22 E VAN NORMAN	4527	06	GARFIELD	47 21	106 26W	2375	14	14	0			
JUDITH GAP	4538	04	WHEATLAND	46 41	109 45W	4690	0	32	0			
JUDITH GAP 13 E	4545	04	WHEATLAND	46 41	109 29W	5100	20	20	0			
KALISPELL WSO AP	R 4558	01	FLATHEAD	48 18	114 16W	2965	34	34	0			C HJ
KILA 9 SSW	4648	01	FLATHEAD	48 0	114 32W	3980	7	7	0		OCT	
KNOBS	4715	07	FALLON	45 55	104 5W	3000	0	32	0			
KREMLIN	4766	03	HILL	48 32	110 6W	2860	0	32	0			
LAKEVIEW	4820	02	BEAVERHEAD	44 36	111 48W	6710	39	41	0			C H
LAME DEER	4839	07	ROSEBUD	45 37	106 39W	3350	43	50	0			
LAUREL	4894	05	YELLOWSTONE	45 40	108 47W	3310	0	32	0			
LENNEP 6 WSW	4954	04	MEAGHER	46 24	110 41W	5880	24	24	0			
LEWISTOWN 10 S	4978	04	FERGUS	46 55	109 25W	4900	0	34	0			
LEWISTOWN FAA AP	4985	04	FERGUS	47 4	109 27E	4132	75	88	0			HJ
LIBBY DAM	5009	01	LINCOLN	48 24	115 18W	2200	15	15	0			
LIBBY 1 NE RANGER STN	5015	01	LINCOLN	48 24	115 32W	2080	77	87	0			C H
LIBBY 32 SSE	5020	01	LINCOLN	47 58	115 13W	3600	32	31	0			H
LIMA	5030	02	BEAVERHEAD	44 39	112 35W	6273	49	61	0			C H
LINCOLN RANGER STATION	5040	04	LEWIS-CLARK	46 57	112 39W	4540	32	33	0			C H
LINDBERGH LAKE	5043	01	MISSOULA	47 24	113 43W	4500	24	24	0			
LINDSAY	5045	06	DAWSON	47 14	105 9W	2690	0	36	0			
LIVINGSTON 12 S	5080	05	PARK	45 29	110 34W	4870	4	32	0			H
LIVINGSTON FAA AP	5086	05	PARK	45 42	110 27W	4653	44	45	0			C H
LOMA 1 WNW	5153	03	CHOUTEAU	47 56	110 31W	2580	26	33	0			H
LUSTRE 4 NNW	5285	06	VALLEY	48 27	105 56W	2920	36	61	0			H
MAC KENZIE	5303	07	FALLON	46 9	104 44W	2810	0	33	0			
MALTA 7 E	5338	03	PHILLIPS	48 24	107 44W	2245	12	12	12			H
MALTA 35 S	5340	03	PHILLIPS	47 50	107 58W	2620	22	24	0			H
MANHATTAN	5351	02	GALLATIN	45 52	111 20W	4230	0	31	0			
MARTINSDALE 3 NNW	5387	04	MEAGHER	46 30	110 20W	4800	46	51	0			C
MEDICINE LAKE 3 SE	5572	06	SHERIDAN	48 29	104 27W	1952	69	70	0			H
MELSTONE	5596	04	MUSSELSHELL	46 36	107 52W	2920	55	65	0			H
MELVILLE 4 W	5603	05	SWEET GRASS	46 6	110 3W	5365	22	23	0			
MENARD 3 NE	5608	02	GALLATIN	46 1	111 8W	5053	0	31	0			
MILDRED 5 N	5668	07	PRAIRIE	46 46	104 58W	2510	5	5	0			
MILES CITY FAA AP	5690	07	CUSTER	46 26	105 52W	2628	46	46	0			C HJ
MISSOULA 2 NE	5735	01	MISSOULA	46 54	113 58W	3420	18	18	0			H
MISSOULA WSO AP	//R 5745	01	MISSOULA	46 55	114 5W	3190	48	48	0			C HJ
MIZPAH 4 NNW	5754	07	CUSTER	46 18	105 17W	2480	23	33	0			H
MOCCASIN EXP STATION	5761	04	JUDITH BASIN	47 3	109 57W	4300	74	74	28			G H
MONIDA	5811	02	BEAVERHEAD	44 34	112 19W	6785	0	30	0			
MOORHEAD 9 NE	5870	07	POWDER RIVER	45 11	105 45W	3220	25	25	0			H
MOSBY 18 N	5873	06	GARFIELD	47 15	107 57W	2320	23	23	0			H

SEE REFERENCE NOTES FOLLOWING STATION INDEX

209-14

REFERENCE NOTES

DEFINITIONS

MONTHLY DEGREE DAY TOTALS: One heating (cooling) degree day is accumulated for each degree that the daily mean temperature is below (above) 65 deg. F

WIND: (As shown in "Evaporation and Wind" table) The total wind movement in miles over the evaporation pan as determined by an anemometer recorder located 6-8 inches above the pan.

NORMALS: The average value of the meteorological element over the time period - 1951-1980. The normals for National Weather Service localities have been adjusted so as to be representative for the current observation site.

DIVISIONS: Areas within a state of similar climatological characteristics.

STATION NAMES: Name of the city, town or locality. Figures and letters following the station names indicate the distance in miles and direction from the post office or town community center.

LETTERS AND SYMBOLS USED IN THE DATA TABLES

- - No record. Data not recorded, determined unreliable by quality control checks, or not received in time for publication.
- * Gage not read. Precipitation is included in the amount following the asterisks. Time distribution not known.
- V Includes total for previous month(s). (See * above)
- // Gage equipped with a windshield.
- A Amount of precipitation is the total of observer's entries for the current month. It may include precipitation that occurred during the previous month. Refer to monthly bulletins to determine date of last reading. (HAWAII stations)
- B Estimated to [illegible] monthly value for wind, evaporation, or cooling degree days.
- M Insufficient or partial data. M is appended to average and/or total values computed with 1-9 daily values missing. M appears alone if 10 or more daily values are missing.
- R Amounts from recording gage.
- T Trace. An amount too small to measure.
- Z Same as M but the Z has overprinted a Negative sign or leading digit (eg. Z14.6 = M-14.6, Z08.2 = M108.2).

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LETTERS AND SYMBOLS USED IN THE STATION INDEX TABLE

- C Station is equipped with recording rain gage (R) but values in this bulletin are from a non-recording gage unless indicated by an R.
- G Observations appear in "Soil Temperatures" table.
- J Station also published as a "Local Climatological Data" publication.
- H Observations appear in "Snowfall and Snow on Ground" table in Monthly Climatological Data publications.
- # Thermometers located in a rooftop shelter.

Additional Information regarding the climate of this state may be obtained by writing to the National Climatic Data Center, Federal Building, Asheville, N.C. 28801-2696, or to any Weather Service Office near you. Additional precipitation data are contained in the "Hourly Precipitation Data" bulletin for each state, except Alaska.

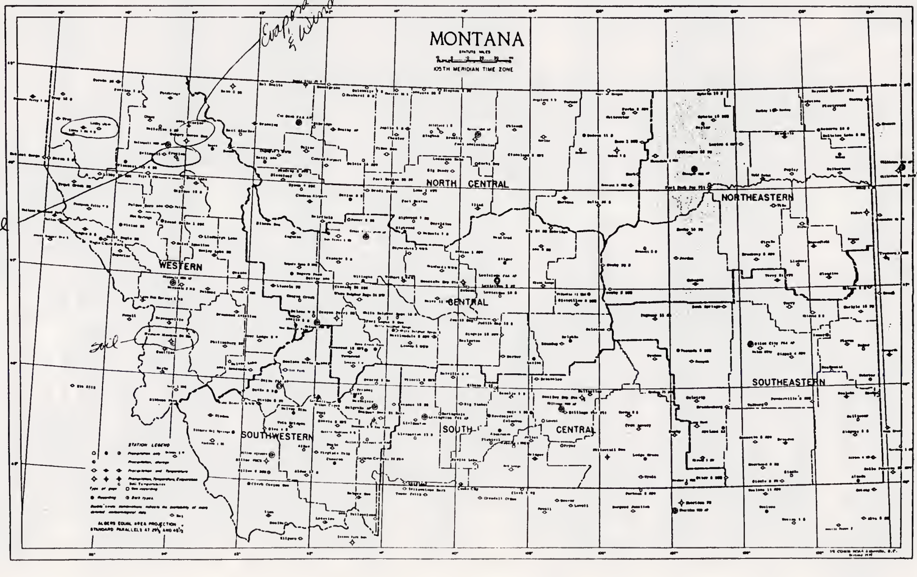
Seasonal Tables: Monthly and seasonal snowfall and heating degree days for the 12 months ending with the June data will be carried in the July issue of this bulletin. Cooling degree days for the calendar year will be published in the "Climatological Data Annual Summary"

Information concerning the history of changes in locations, exposure, etc. of substations through 1955 is available in the "Substation History" publication. Subsequent historical information is kept on file at the National Climatic Data Center. Similar information for regular National Weather Service Offices may be obtained from the "Local Climatological Data" annual publication.

SUBSCRIPTION, PRICE AND ORDERING INFORMATION AVAILABLE FROM:
THE NATIONAL CLIMATIC DATA CENTER, FEDERAL BUILDING,
ASHEVILLE, N. C. 28801-2696

USCOMM-NOAA-ASHEVILLE, N.C. 1983-0945

Evaporation & Wind Movement



Soil

Soil

209-16

208: Identify Sites

INTRODUCTION:

Working with the W.R. Grace staff, three potential sites were identified. These sites were selected because they are located adjacent to the mine's major processing facilities. The nature of the energy conversion equipment requires that it be located next to the energy using facility. The sites were also located to facilitate the delivery of bulk fuels - wood and coal.

Task Description

For the preceding sites selected, prepare the following site evaluation data:

- Soil Conditions for Foundations
- Accessibility
- Utilities
- Ownership
- Weather Data
- Hydrology
- Land Use
- Population Density

Accessibility

All sites are accessable by the existing mine service road system. No major road construction would be necessary for any of the sites.

Land Use

All sites are on private property owned by W.R. Grace & Company. Sites A and C are on or adjacent to existing mine processing buildings. Site B is adjacent to the existing mine water wells.

Utilities

All three sites are served by the same electric utility, Pacific Power & Light Co. The mine has its own water supply system. Oil and propane are purchased from local suppliers.

Population Density

The nearest population center is Libby, Montana, located seven miles downstream to the west. W.R. Grace & Co. owns 2900 acres. The mine is located in the middle of this property.

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